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Negishi

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(54) **ORGANIC EL DISPLAY DEVICE AND ELECTRONIC APPARATUS**

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H01L 27/32 (2006.01)
H01L 51/52 (2006.01)

(52) **U.S. Cl.**

CPC ***H01L 27/3246*** (2013.01); ***H01L 27/3213*** (2013.01); ***H01L 27/3258*** (2013.01); ***H01L 27/3276*** (2013.01); ***H01L 51/5246*** (2013.01)

(58) **Field of Classification Search**

CPC H01L 27/3246; H01L 27/3213
See application file for complete search history.

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(57) **ABSTRACT**

An organic EL display device includes a display region where a plurality of pixels having a light-emitting device stacked in order of an organic layer including a first electrode and a light-emitting layer, and a second electrode from a substrate, are arranged, a peripheral region having a peripheral circuit that is arranged on an outer edge side of the display region, a lower layer-sided first insulating layer and an upper layer-sided second insulating layer that are arranged to be extended to the peripheral region from the display region, a first separation groove that is arranged in the first insulating layer between the display region and the peripheral region, a first conductive layer that is arranged on the first insulating layer of the peripheral region, a first covering portion, a sealing portion that is arranged on an outer edge side of the first covering portion, and a second covering portion.

20 Claims, 16 Drawing Sheets

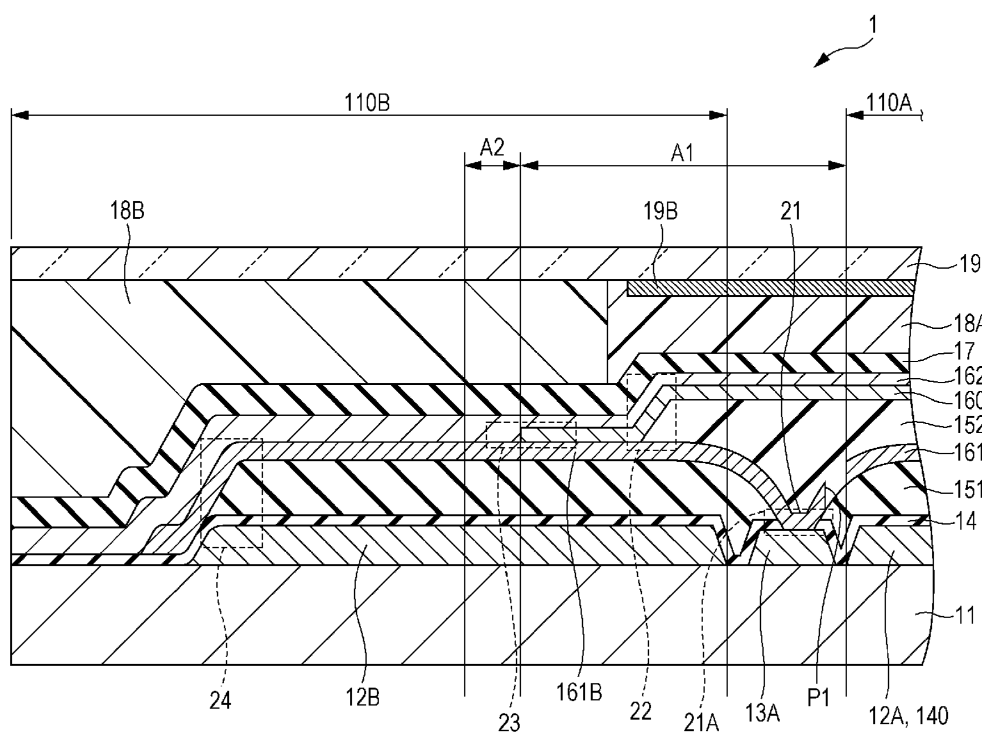
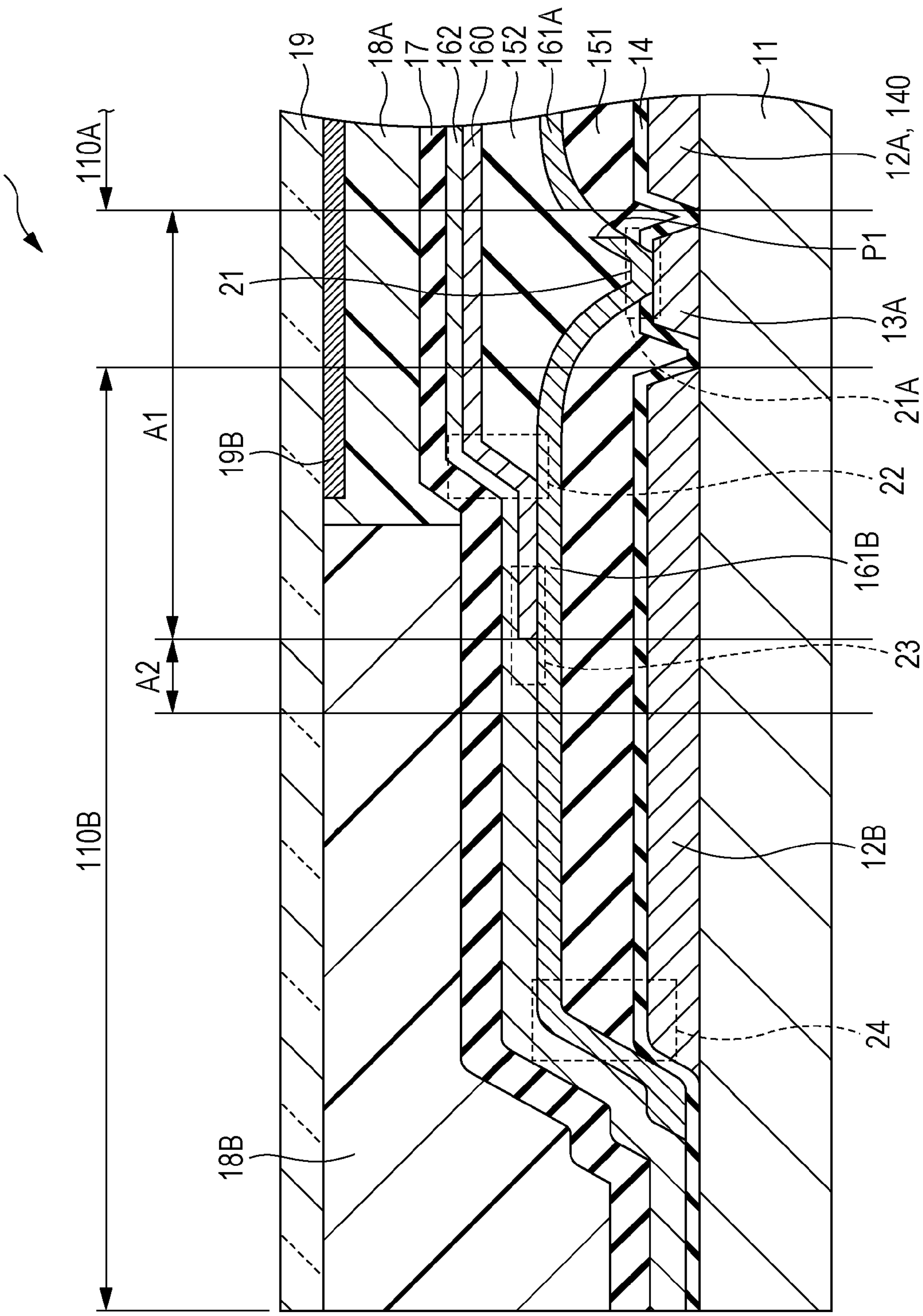


FIG. 1


1
19
18A
17
162
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11
110A
12A, 140
P1
21
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A1
19B
22
161B
23
A2
110B
12B
24
18B

FIG. 2

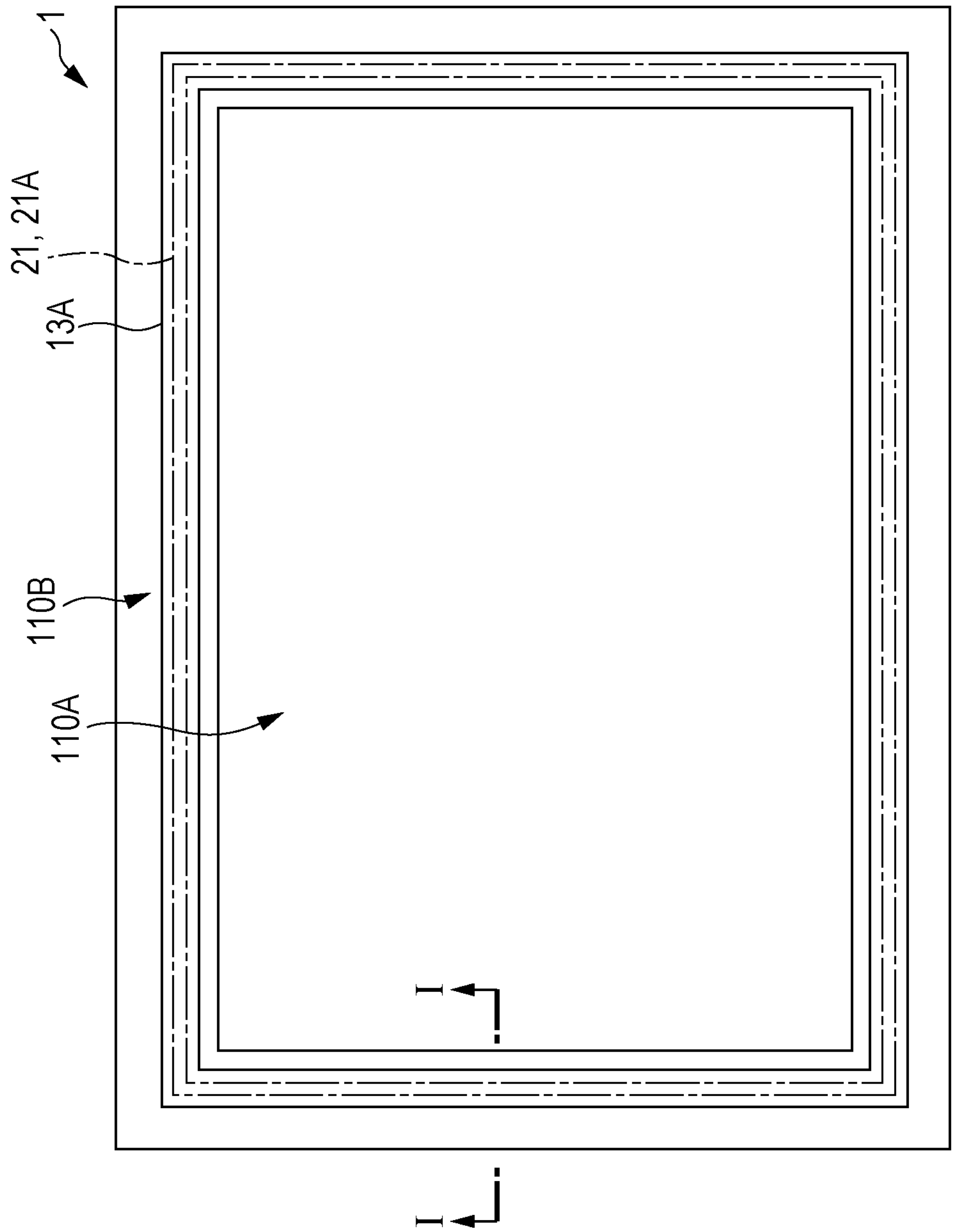


FIG. 3

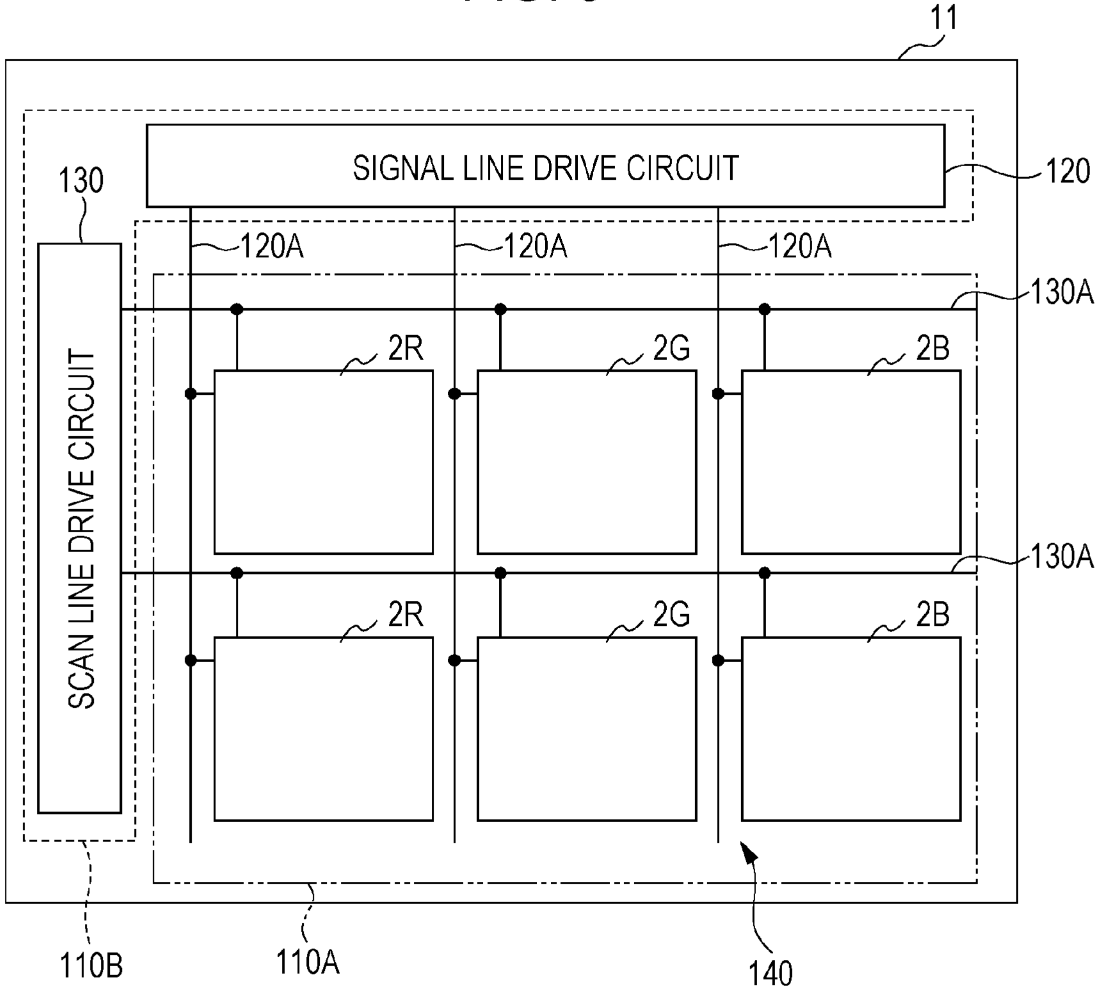

11
SIGNAL LINE DRIVE CIRCUIT
120
130
120A
120A
120A
130A
2R
2G
2B
SCAN LINE DRIVE CIRCUIT
130A
2R
2G
2B
110B
110A
140

FIG. 4

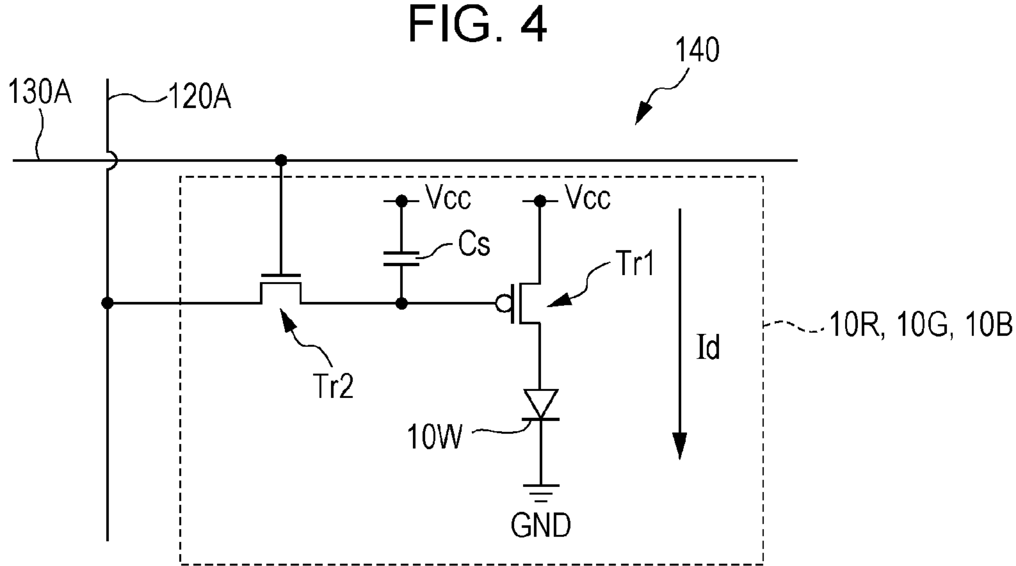
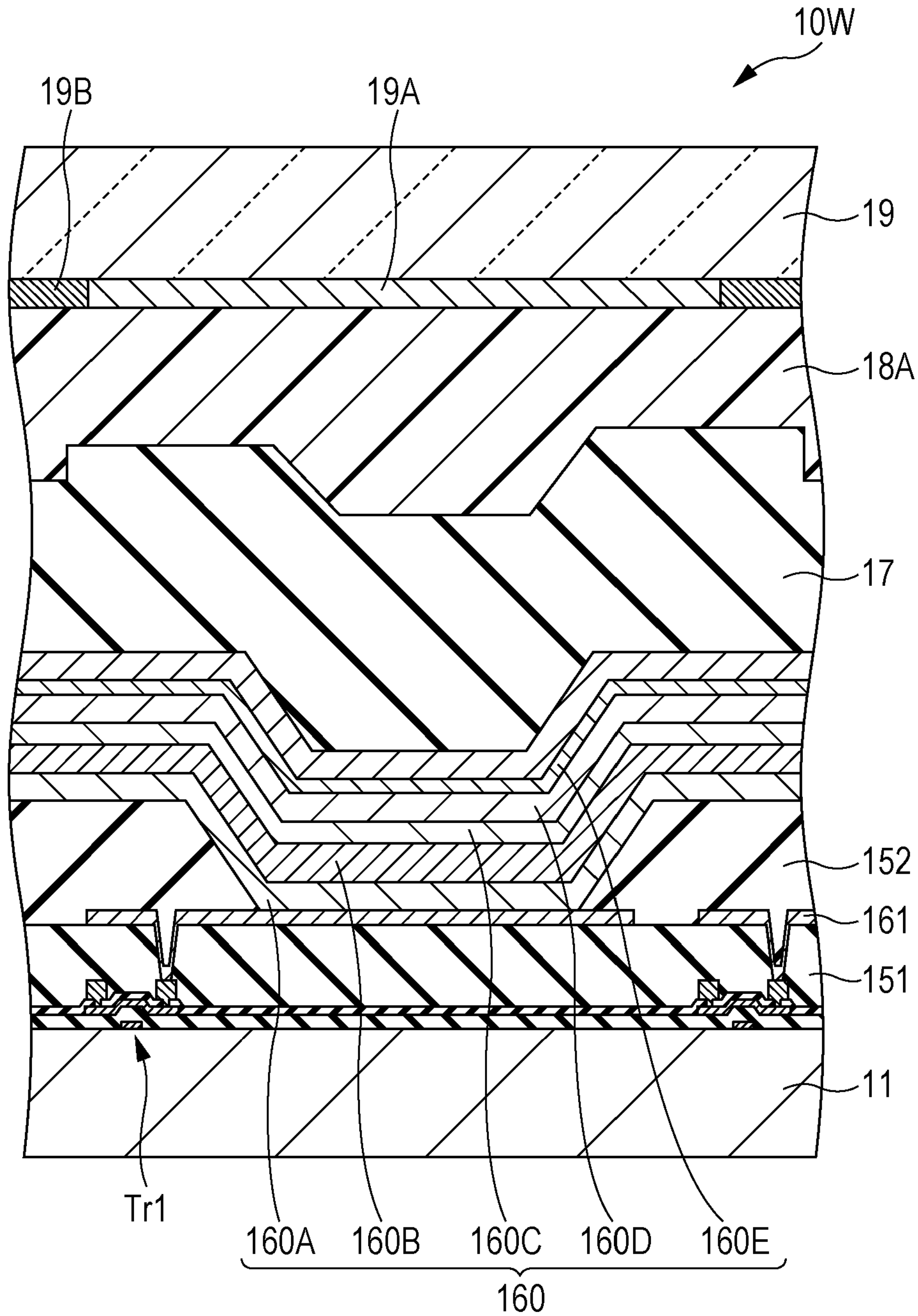

140
130A
120A
Vcc
Vcc
Cs
Tr1
10R, 10G, 10B
Id
Tr2
10W
GND

FIG. 5


10W
19B
19A
19
18A
17
152
161
151
11
Tr1
160A
160B
160C
160D
160E
160

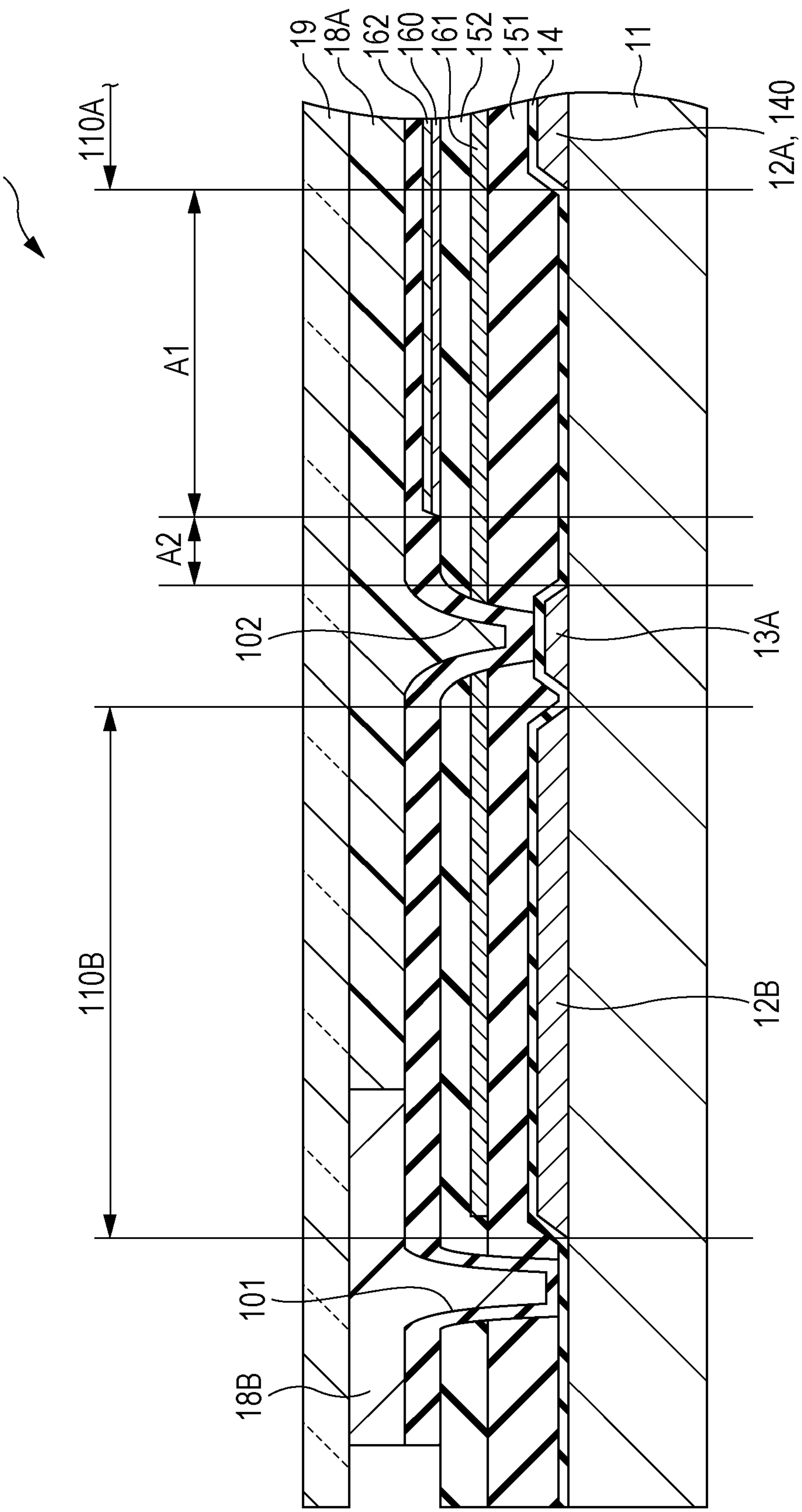
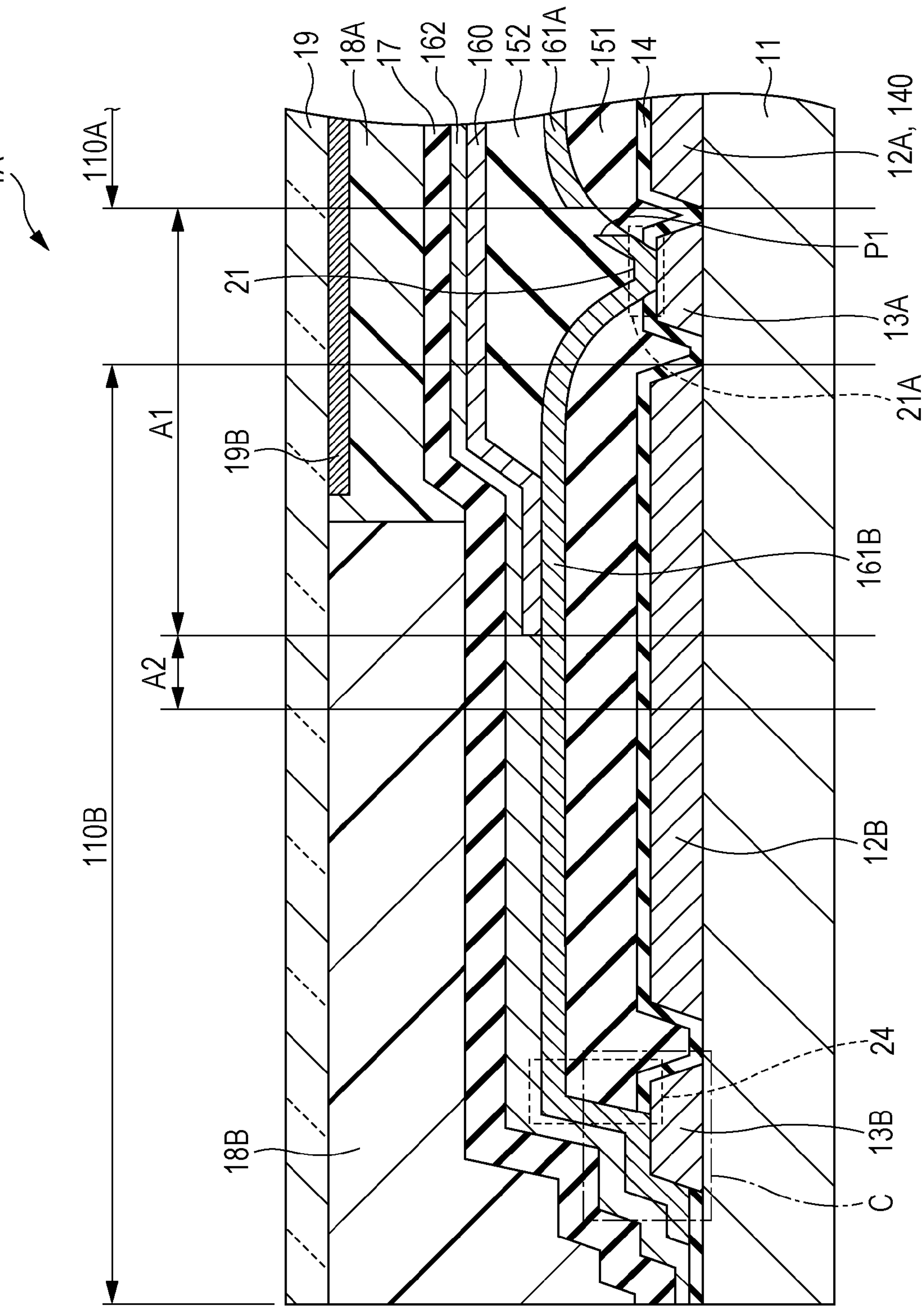

100
110A
A1
A2
110B
19
18A
162
160
161
152
151
14
11
12A, 140
13A
12B
102
101
18B

FIG. 6

FIG. 7


1A
110A
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A1
A2
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152
161A
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12A, 140
P1
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13A
21A
19B
161B
12B
24
13B
18B
C

FIG. 8

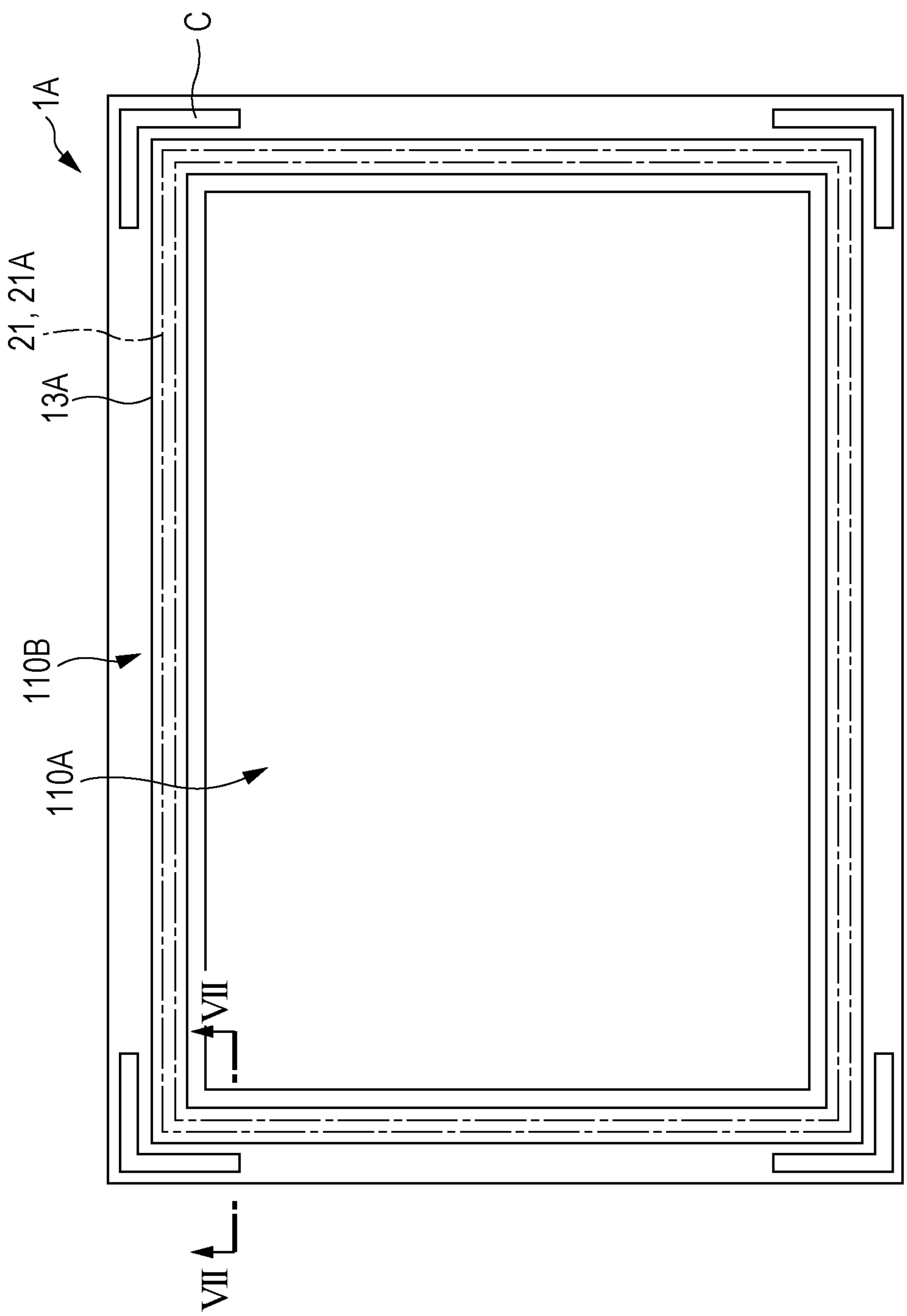
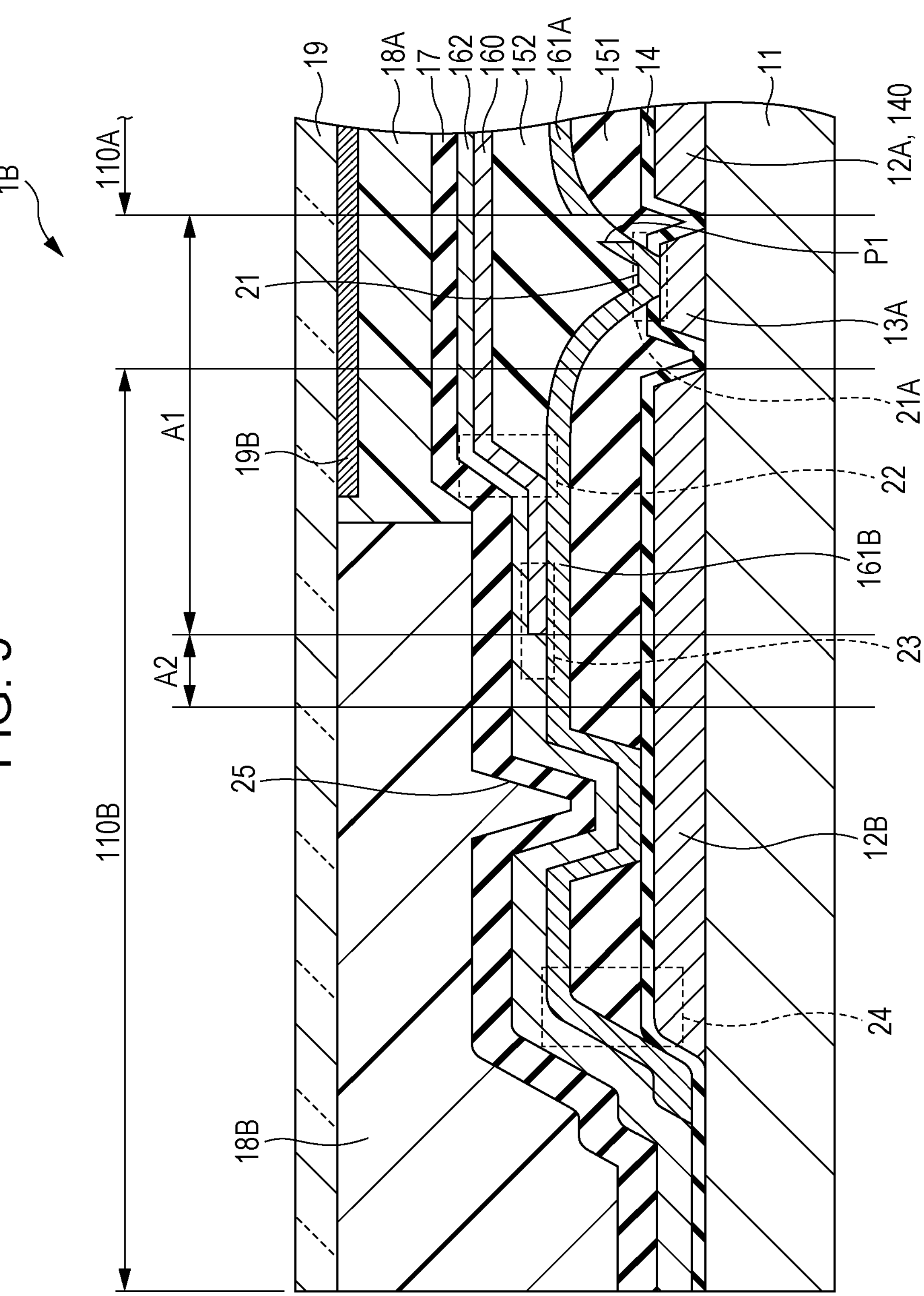


FIG. 9


1B
110A
110B
A1
A2
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18A
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160
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161A
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P1
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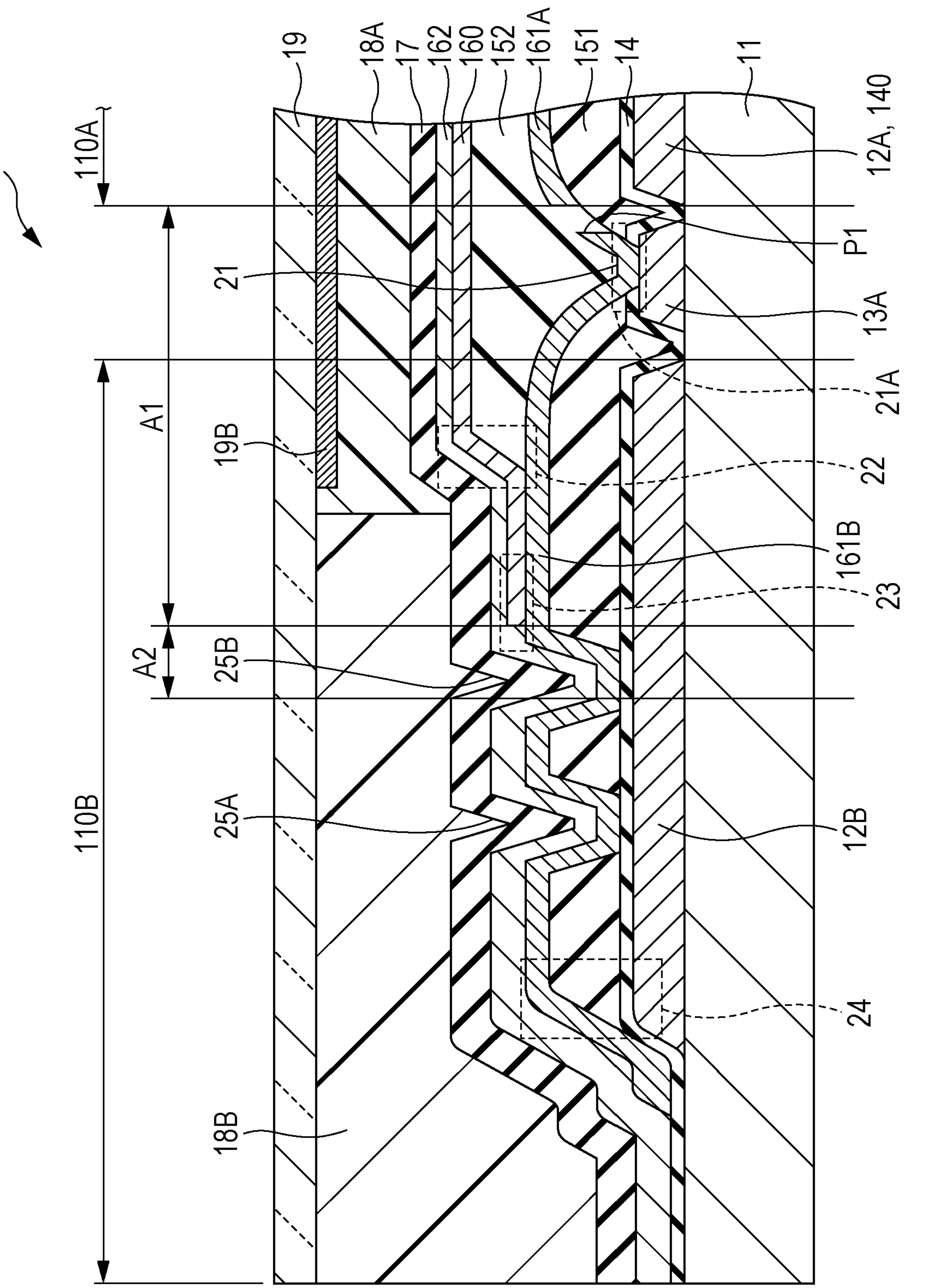
13A
21A
19B
22
161B
23
25
12B
24
18B

FIG. 10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110A
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A1
A2
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161A
151
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P1
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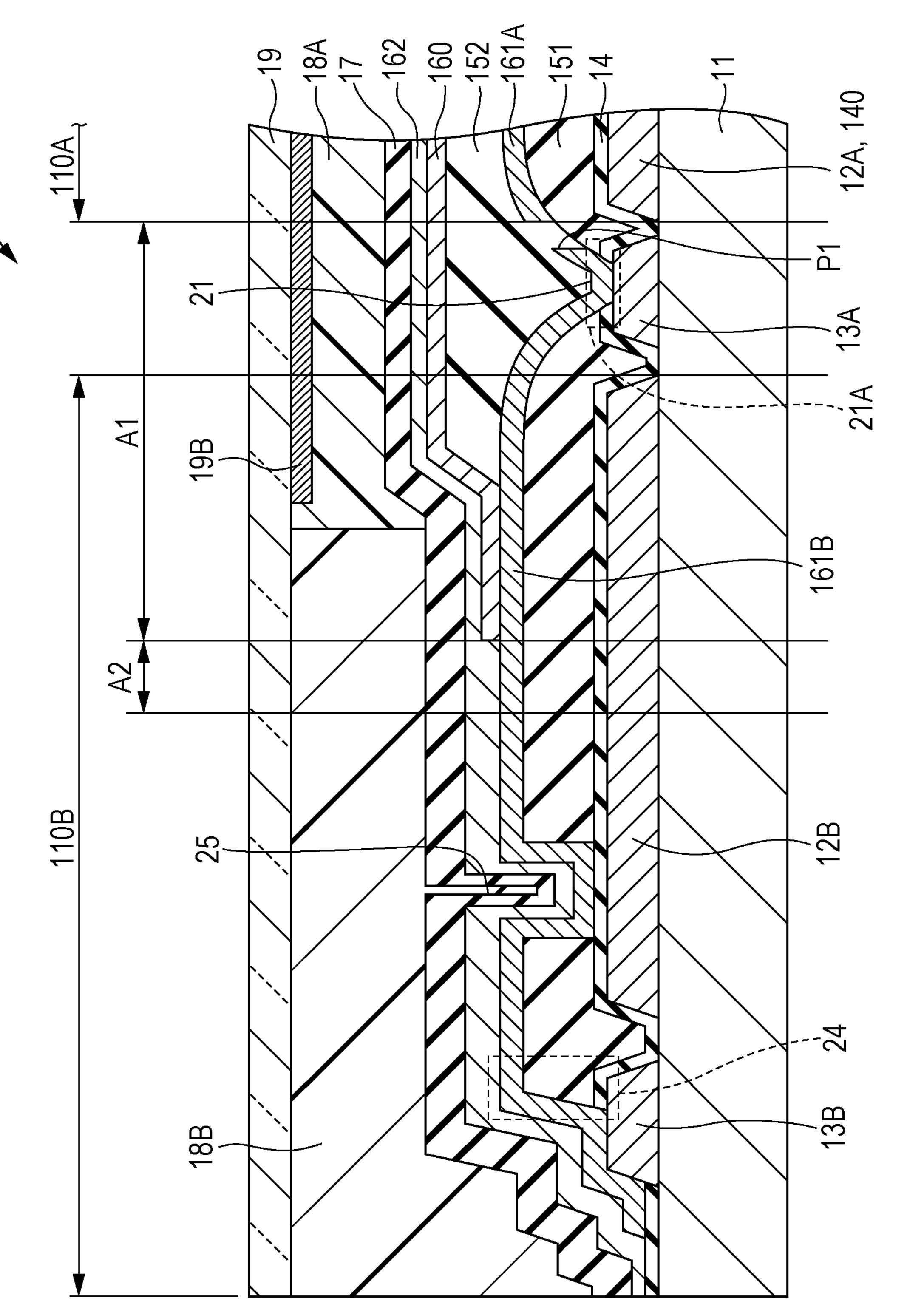
13A
21A
19B
22
161B
23
25B
25A
12B
24
18B

FIG. 11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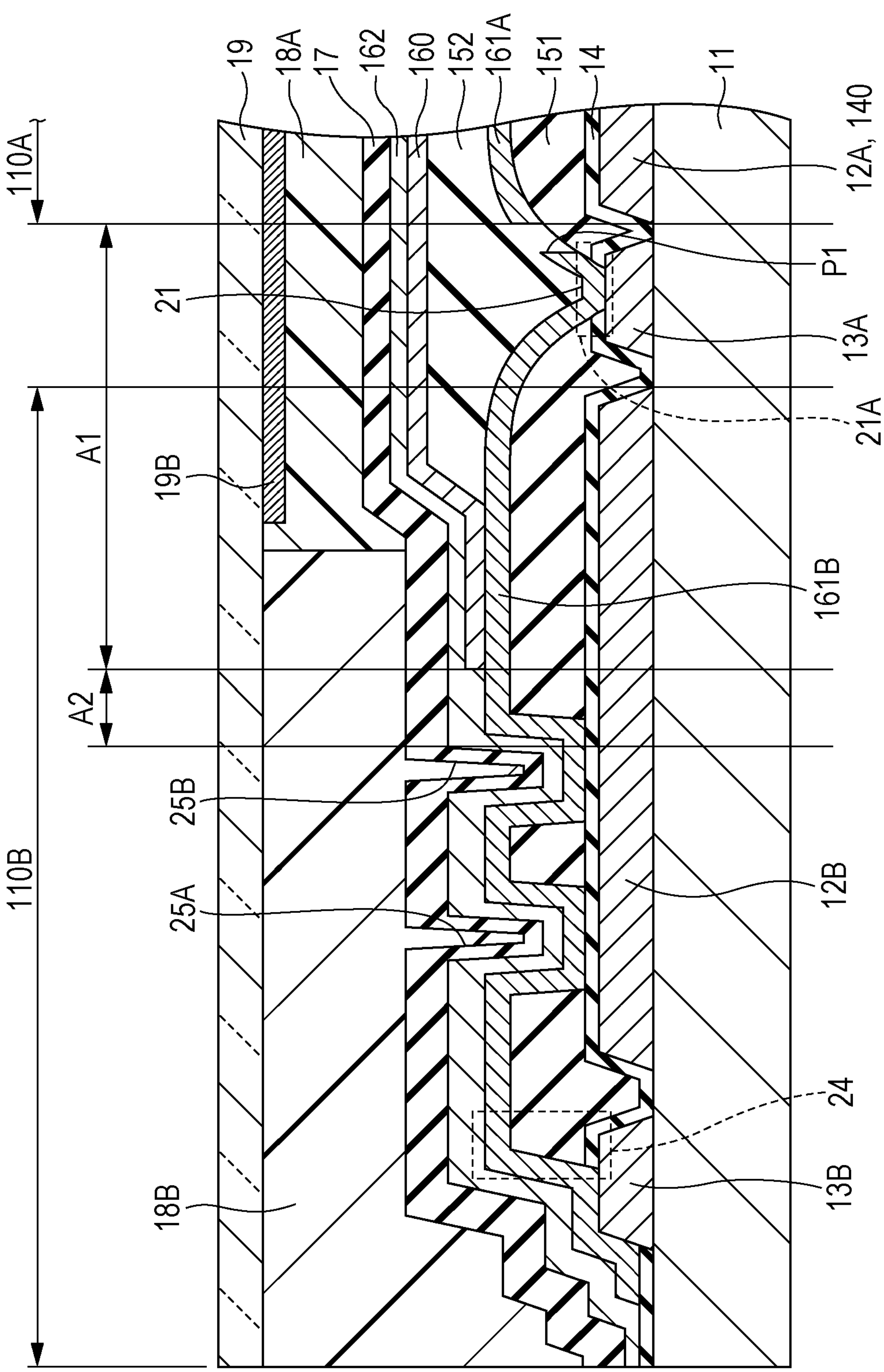
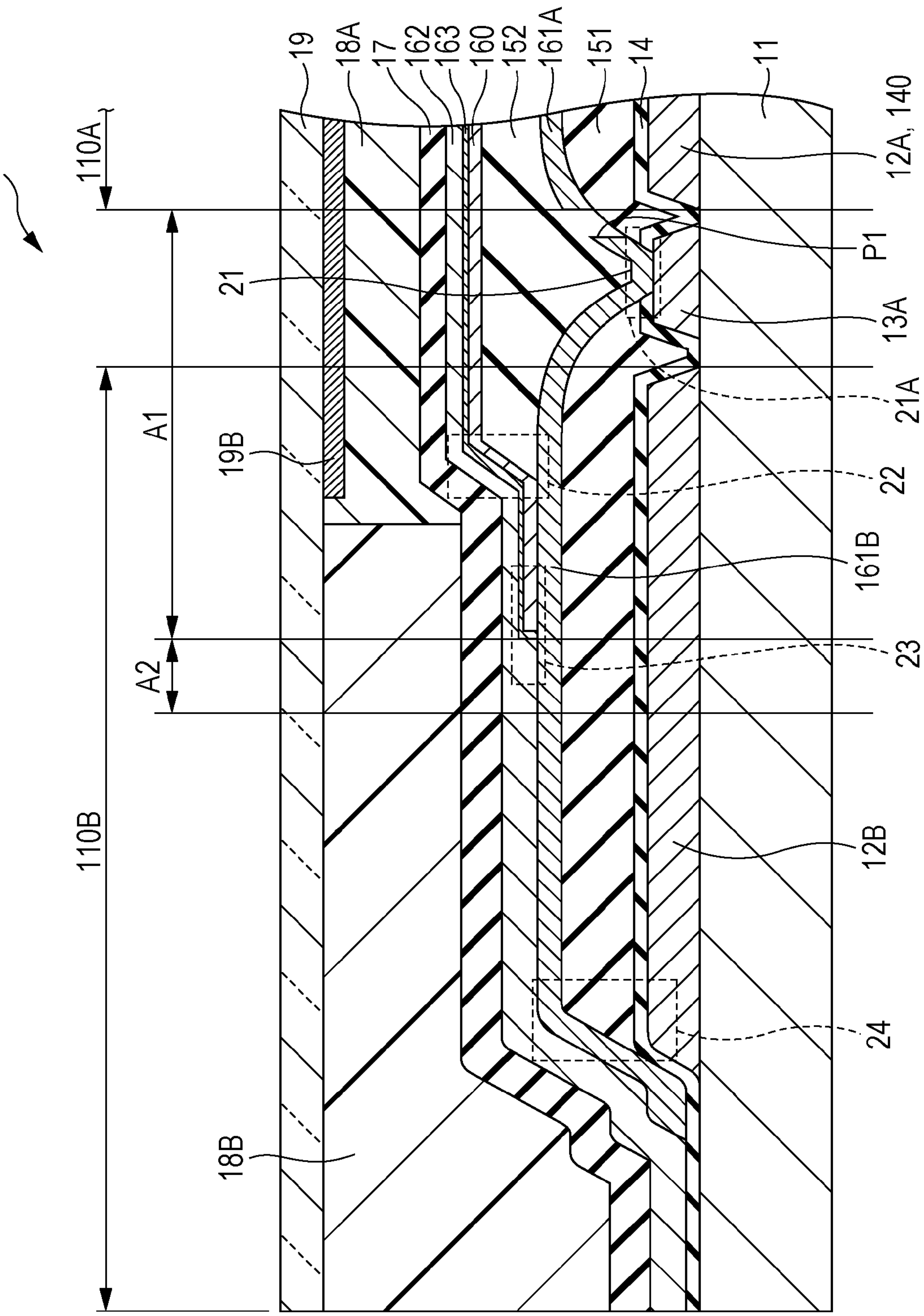
21A
A1
19B
161B
A2
110B
25
12B
24
13B
18B

FIG. 12



1E
110A
110B
A1
A2
19
18A
17
162
160
152
161A
151
14
11
12A, 140
P1
13A
21A
21
19B
161B
25B
25A
12B
24
13B
18B

FIG. 13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110A
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161A
151
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12A, 140
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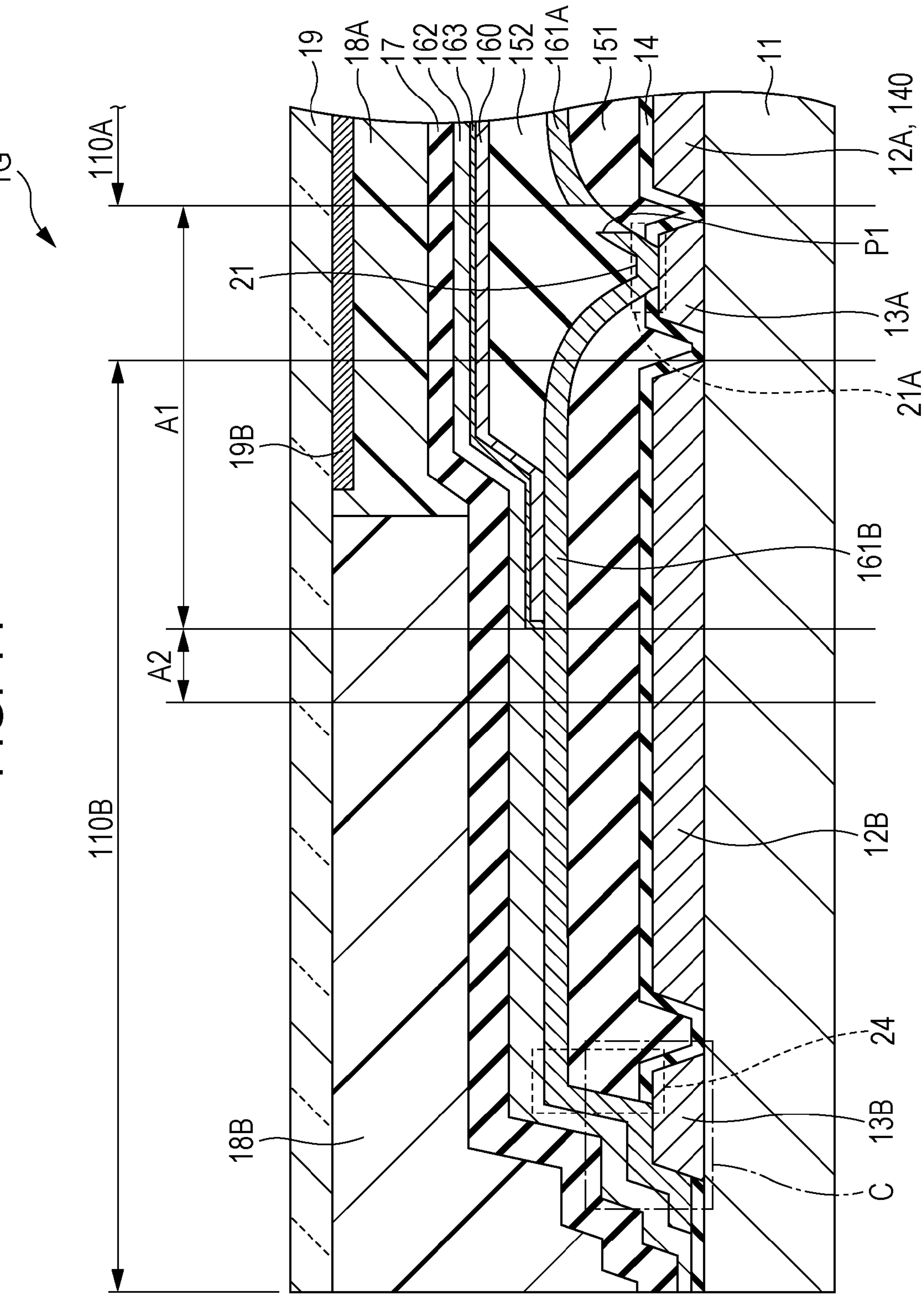
13A
21A
A1
19B
22
161B
A2
23
110B
12B
24
18B

FIG. 14


1G
110A
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18A
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162
163
160
152
161A
151
14
11
12A, 140
P1
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21A
A1
19B
161B
A2
110B
12B
24
13B
C
18B

FIG. 15A

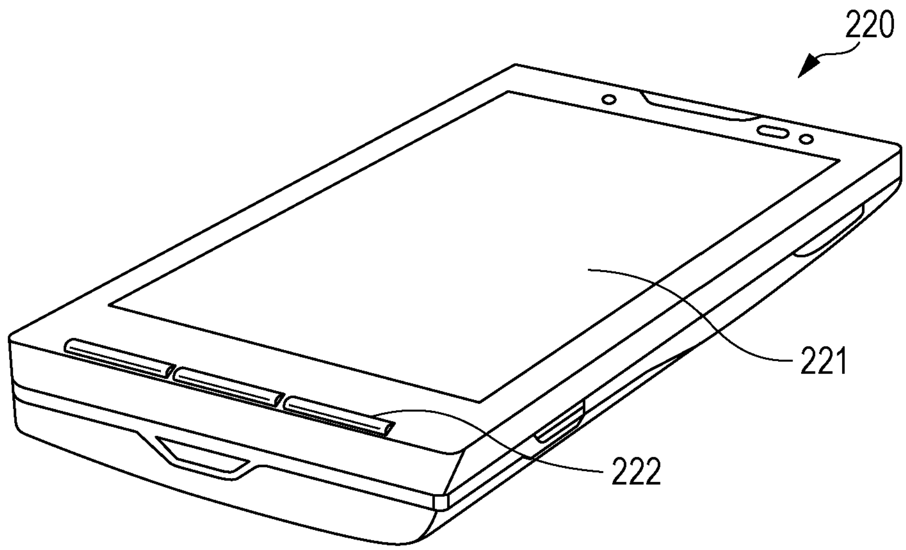


FIG. 15B

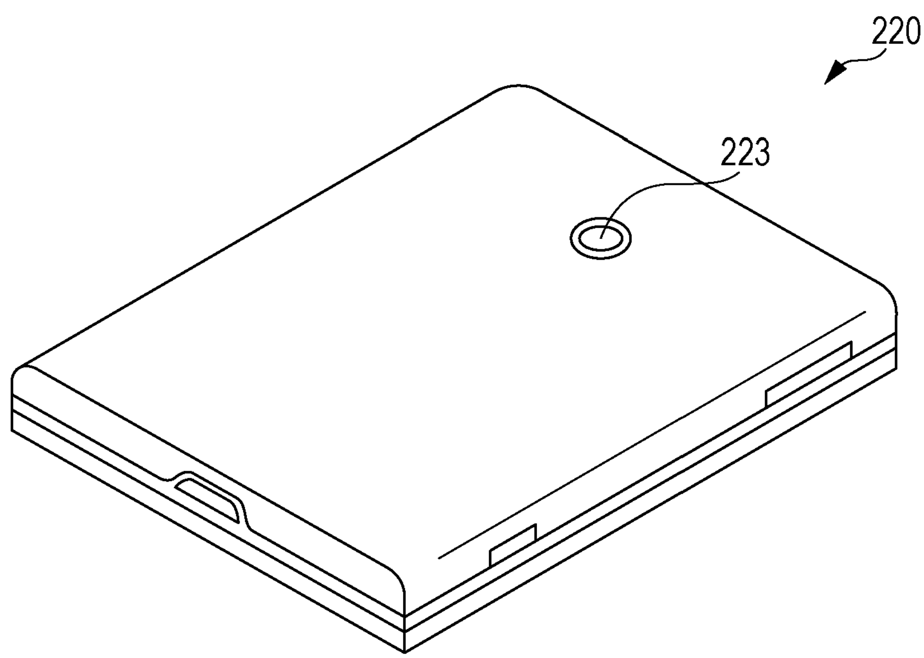


FIG. 16

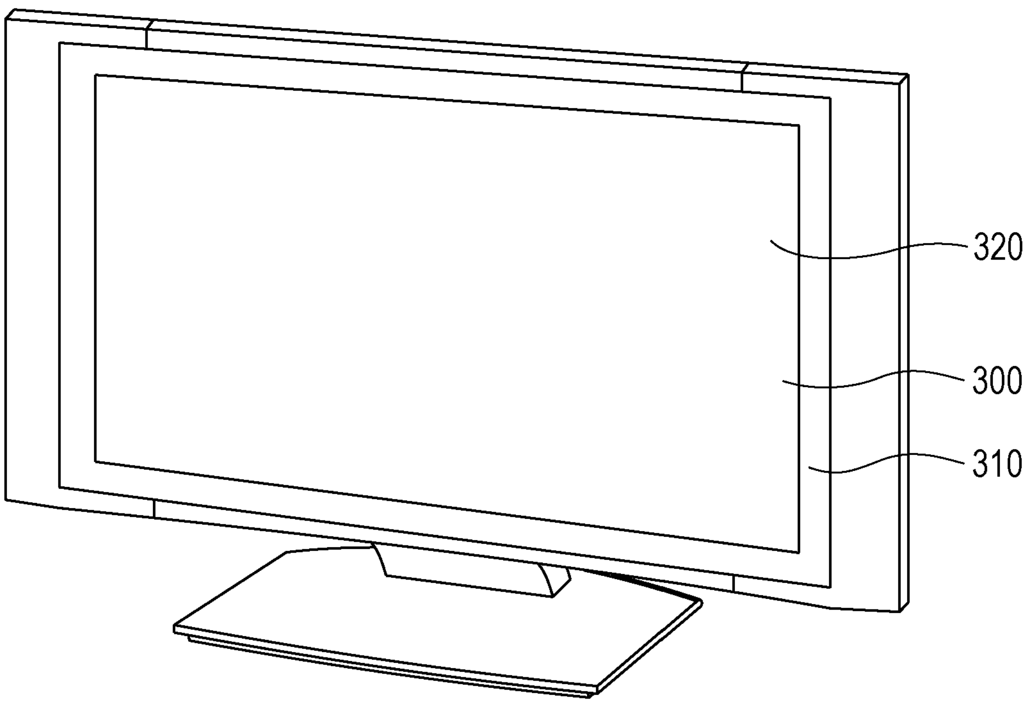


FIG. 17A

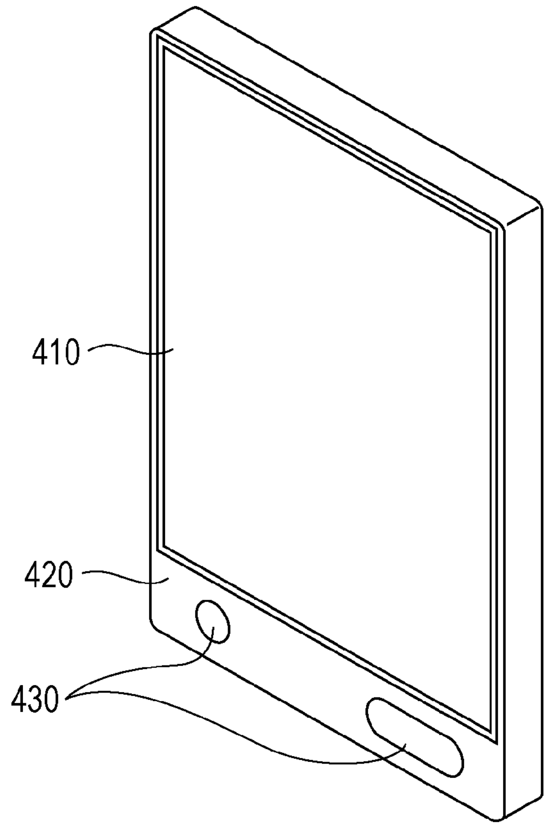
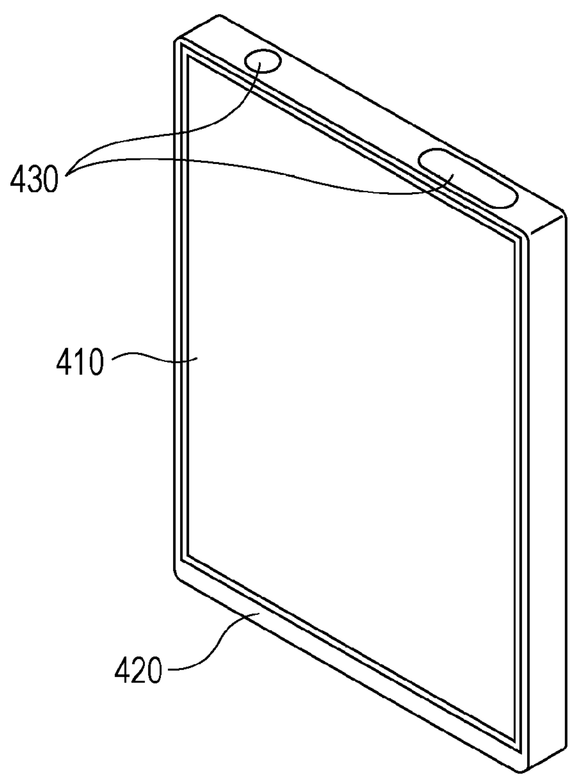


FIG. 17B



ORGANIC EL DISPLAY DEVICE AND ELECTRONIC APPARATUS

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of Japanese Priority Patent Application JP 2014-064423 filed Mar. 26, 2014, the entire contents of which are incorporated herein by reference.

BACKGROUND

The present disclosure relates to an organic EL display device which emits light using an organic electro luminescence (EL) phenomenon, and an electronic apparatus including the organic EL display device.

An organic EL device which emits light using an EL phenomenon of an organic material, is configured to arrange an organic layer by stacking an organic positive hole transport layer and an organic light-emitting layer between an anode and a cathode, and is attracted attention as a light-emitting device which can emit the light at high luminance by a low voltage direct current drive. However, a display device (organic EL display device) using the organic EL device, has problems that time-dependent stability is low and a lifespan is short, such that deterioration of the organic layers due to moisture absorption is generated in the organic EL device, the light-emitting luminance is lowered, or the emitting of the light is unstable in the organic EL device.

For example, in Japanese Unexamined Patent Application Publication No. 2002-93576, it is proposed an organic EL display device in which a cover material for sealing is placed on a device formation face side where the organic EL device and other circuits are formed in a substrate, and a peripheral portion of the substrate and the cover material is sealed by a seal material. Additionally, in Japanese Unexamined Patent Application Publication No. 2002-93576, it is proposed a configuration of covering an outside of the seal material by a hard carbon film as a protective film for preventing infiltration of water vapor or the like. By such the configuration, the organic EL device which is formed on the substrate is totally blocked from the outside, and it is possible to prevent a material such as moisture or oxygen which promotes the deterioration due to oxidation of the organic EL device from being infiltrated from the outside.

In addition thereto, it is proposed a total solid type organic EL display device in which the cover material for sealing is bonded to the device formation face side where the organic EL device and other circuits are formed in the substrate, through an adhesive agent.

SUMMARY

In the organic EL display device, generally, an interlayer insulating layer is arranged in a state of covering a drive circuit which is configured using a thin film transistor (TFT), and the organic EL devices are configured to form an array on the interlayer insulating layer. In this case, in order to form the organic EL device on a face that is flattened by reducing a level difference which is generated due to the formation of the drive circuit, for example, the interlayer insulating layer is formed of a flattening film using an organic photosensitive insulating layer or the like. However, since the interlayer insulating layer (organic insulating layer) which is made up of the organic material is likely to pass the moisture, the moisture is infiltrated from a cross section of the interlayer insulating layer which is exposed to the atmosphere, and there is a problem of deteriorating the organic EL device.

In order to solve the problems, it is proposed an organic EL display device in which a separation groove that separates the organic insulating layer described above from an inner region side thereof and an outer region side thereof is formed in a position (outer edge side of a display region) surrounding the display region (for example, see Japanese Unexamined Patent Application Publication No. 2006-54111 and Japanese Unexamined Patent Application Publication No. 2008-283222). By arranging the separation groove, the moisture which is present on the outer region side in the organic insulating layer, is avoided from infiltrating the inner region side (display region side) by passing through an inside of the organic insulating layer. Consequently, as described above, it is possible to suppress the deterioration of the organic layer (organic EL device) which is caused by that the moisture left behind in the display device passes through the organic insulating layer.

However, in a structure which is proposed in Japanese Unexamined Patent Application Publication No. 2006-54111 and Japanese Unexamined Patent Application Publication No. 2008-283222, for example, when an area mask is used at the time of forming a film with the organic layer such as a white organic EL device, since the following problems are generated, there is a room for improvement. That is, in this case, in consideration of an alignment shift (mask shift region) of the area mask and wraparound (taper region) of the film, the separation groove is necessary to be formed in the position which is sufficiently distant from the display region, in actuality. Hence, a necessity to widen a frame is generated (necessity to widen a distance between the display region and a peripheral region is generated), and it is difficult to achieve frame narrowing (size reduction of the display device, and cost reduction). Additionally, since the necessity to widen the distance between the display region and the peripheral region is generated, the moisture which is included within the organic insulating layer infiltrates the organic layer in the region (inner region of the separation groove), and thereby, the organic layer deteriorates.

It is desirable to provide an organic EL display device which is capable of improving reliability of an organic EL device while achieving frame narrowing, and an electronic apparatus including the organic EL display device.

An organic EL display device according to an embodiment of the present disclosure, includes a display region where a plurality of pixels having a light-emitting device which is stacked respectively in order of an organic layer including a first electrode and a light-emitting layer, and a second electrode from a substrate side, are arranged, a peripheral region that is arranged on an outer edge side of the display region, and has a peripheral circuit, a first insulating layer of a lower layer side and a second insulating layer of an upper layer side that are arranged so as to be extended to the peripheral region from the display region, a first separation groove that is arranged in the first insulating layer between the display region and the peripheral region, a first conductive layer that is arranged on the first insulating layer of the peripheral region, through a bottom portion from a side face of the first separation groove, a first covering portion where at least an end face of the second insulating layer is covered by the organic layer or the second electrode, a sealing portion that is arranged on an outer edge side of the first covering portion, and is configured by stacking the first conductive layer and the second electrode, and a second covering portion where an end face of an outer edge side of the first insulating layer which is separated from the peripheral region side by the first separation groove, is covered by the first conductive layer.

An electronic apparatus according to another embodiment of the present disclosure, includes the organic EL display device of the present disclosure.

In the organic EL display device and the electronic apparatus according to the embodiments of the present disclosure, the first separation groove that separates the first insulating layer from the display region and the peripheral region, is formed between the display region and the peripheral region. In the peripheral region, the first covering portion where the end face of the second insulating layer is covered by the organic layer or the second electrode, and the sealing portion that is configure by stacking the first conductive layer and the second electrode in the outer edge side than the first covering portion, are arranged. Hereby, the separation groove that separates the first insulating layer and the second insulating layer, is formed in the region of a portion of an outer edge side of a formation region of the organic layer, differently from the related art. Therefore, the moisture which is included within the first insulating layer and the second insulating layer, is avoided from infiltrating the organic layer in the outer edge side (corresponding to the inner region of the separation groove in a case of the related art) of the first separation groove. Moreover, by arranging the second covering portion where the end face of the outer edge side of the first insulating layer which is separated by the first separation groove is covered by the first conductive layer, at the further outer edge, the infiltration of the moisture to the organic layer through the first insulating layer from the outside, is reduced.

According to the organic EL display device and the electronic apparatus of the embodiments of the present disclosure, the first separation groove is arranged in the first insulating layer between the display region and the peripheral region, and the first covering portion where the end face of the second insulating layer is covered by the organic layer or the second electrode, and the sealing portion that is configure by stacking the first conductive layer and the second electrode, are formed in the peripheral region. Hereby, the moisture which is included within the first insulating layer and the second insulating layer on the outer edge side of the first separation groove, can be avoided from infiltrating the organic layer. Furthermore, since the second covering portion where the end face of the outer edge side of the first insulating layer of the peripheral region which is separated by the first separation groove is covered by the first conductive layer is arranged, it is possible to prevent the infiltration of the moisture or the like, to the first insulating layer from the outside. Hereby, it is possible to further reduce the infiltration of the moisture or gas which has a concern of deteriorating the organic layer. Accordingly, it is possible to provide the display device of which the reliability is high by suppressing the deterioration of the organic EL device while achieving the frame narrowing. The effects that are described here, are not necessarily limited, and may be any one of the effects which are described in the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross-sectional view illustrating a configuration of an organic EL display device according to an embodiment of the present disclosure;

FIG. **2** is a plan view of the organic EL display device shown in FIG. **1**;

FIG. **3** is a diagram illustrating an overall configuration of the organic EL display device shown in FIG. **1**;

FIG. **4** is a diagram illustrating an example of a pixel drive circuit shown in FIG. **3**;

FIG. **5** is a cross-sectional view of an organic EL device configuring the organic EL display device shown in FIG. **1**;

FIG. **6** is a cross-sectional view illustrating a configuration of an organic EL display device according to Comparative Example;

FIG. **7** is a cross-sectional view illustrating a configuration of an organic EL display device according to Modification Example 1;

FIG. **8** is a plan view of the organic EL display device shown in FIG. **7**;

FIG. **9** is a cross-section view illustrating an example of a configuration of an organic EL display device according to Modification Example 2;

FIG. **10** is a cross-sectional view illustrating another example of the configuration of the organic EL display device according to Modification Example 2;

FIG. **11** is a cross-sectional view illustrating another example of the configuration of the organic EL display device according to Modification Example 2;

FIG. **12** is a cross-sectional view illustrating another example of the configuration of the organic EL display device according to Modification Example 2;

FIG. **13** is a cross-sectional view illustrating an example of a configuration of an organic EL display device according to Modification Example 3;

FIG. **14** is a cross-sectional view illustrating another example of the configuration of the organic EL display device according to Modification Example 3;

FIG. **15**A is a perspective view illustrating an appearance when seen from a front side of Application Example 1 of a display device using a pixel of the embodiment;

FIG. **15**B is a perspective view illustrating the appearance when seen from a back side of Application Example 1 of the display device using the pixel of the embodiment;

FIG. **16** is a perspective view illustrating an appearance of Application Example 2;

FIG. **17**A is a perspective view illustrating an example of an appearance of Application Example 3; and

FIG. **17**B is a perspective view illustrating another example of the appearance of Application Example 3.

DETAILED DESCRIPTION OF EMBODIMENTS

Hereinafter, embodiments of the present disclosure will be described with reference to the drawings. The description will be performed in the following order.

1. Embodiment (example of arranging first covering portion and second covering portion)
2. Modification Example

Modification Example 1 (example of arranging metal layer at outer edge than first separation groove)

Modification Example 2 (example of arranging a plurality of separation grooves in addition to first separation groove)

Modification Example 3 (example of arranging high resistance layer between organic layer and second electrode)

3. Application Example (application example to electronic apparatus)

1. Embodiment

Overall Configuration Example of Organic EL Display Device

FIG. **1** is a diagram illustrating a cross-sectional configuration of an organic EL display device (organic EL display device **1**) according to an embodiment of the present disclosure. The organic EL display device **1** is an device which is used as an organic EL television device or the like. As shown in FIG. **2**, on a substrate **11**, a display region **110**A is arranged, and a peripheral region **110**B is arranged in the vicinity of the display region **110**A. For example, the organic EL display device **1** is an upper face light-emitting type (so-called top emission type) display device in which any one color light of R (red), G (green), and B (blue) exits from an upper face (opposite face to the substrate **11**) side by using a white organic EL device **10**W and a color filter **19**A described later (see FIG. **5**). FIG. **1** is a cross-sectional view of an organic EL display device **1**A along an I-I line shown in FIG. **2**. FIG. **3** is a diagram illustrating an example of an overall configuration of the organic EL display device **1** shown in FIG. **1**, and within the display region **110**A, a plurality of pixels **2** (red pixel **2**R, green pixel **2**G, and blue pixel **2**B) are placed in a matrix shape. Moreover, a signal line drive circuit **120** and a scan line drive circuit **130** which are drivers (peripheral circuit **12**B described later) for a video display, are arranged in the peripheral region **110**B which is positioned in the vicinity (outer edge side and outer periphery side) of the display region **110**A.

Within the display region **110**A, a pixel drive circuit **140** is arranged. FIG. **3** is a diagram illustrating an example (example of a pixel circuit of the red pixel **2**R, the green pixel **2**G, and the blue pixel **2**B) of the pixel drive circuit **140**. The pixel drive circuit **140** is an active type drive circuit which is formed in a lower layer of a lower electrode **161** described later. The pixel drive circuit **140** has a drive transistor Tr**1**, a write-in transistor Tr**2**, and a capacitor (storage capacitor) Cs between the transistors Tr**1** and Tr**2**. Moreover, the pixel drive circuit **140** has the white organic EL device **10**W which is connected to the drive transistor Tr**1** in series, between a first power supply line (Vcc) and a second power supply line (GND). That is, the white organic EL devices **10**W are respectively arranged within the red pixel **2**R, the green pixel **2**G, the blue pixel **2**B. The drive transistor Tr**1** and the write-in transistor Tr**2** are configured by general thin film transistors (TFT). For example, the configuration may be a reverse stagger structure (so-called bottom gate type), or may be a stagger structure (top gate type), and may not be limited in particular.

In the pixel drive circuit **140**, a plurality of signal lines **120**A are placed in a column direction, and a plurality of scan lines **130**A are placed in a row direction. An intersection of each signal line **120**A and each scan line **130**A corresponds to any one of the red pixel **2**R, the green pixel **2**G, and the blue pixel **2**B. Each signal line **120**A is connected to the signal line drive circuit **120**, and an image signal is supplied to a source electrode of the write-in transistor Tr**2**, through the signal line **120**A from the signal line drive circuit **120**. Each scan line **130**A is connected to the scan line drive circuit **130**, and a scan signal is sequentially supplied to a gate electrode of the write-in transistor Tr**2**, through the scan line **130**A from the scan line drive circuit **130**.

As shown in FIG. **1**, in the organic EL display device **1** of the embodiment, a separation groove **21** (first separation groove) is formed in an organic insulating layer **151** (first insulating layer) between the display region **110**A and the peripheral region **110**B. Moreover, at an outer edge than the separation groove **21**, a covering portion **22** (first covering portion) where an end face of an organic insulating layer **152** which is arranged continually from the display region **110**A so as to bury the separation groove **21**, is covered by an organic layer **160** described later or an upper electrode **162**, and a covering portion **24** (second covering portion) where an end face of an outer edge side of the organic insulating layer **151** which is separated from the peripheral region **110**B side by the separation groove **21**, is covered by a conductive layer **161**B, are arranged. Furthermore, a sealing portion **23** where the conductive layer **161**B and the upper electrode **162** are stacked, is arranged between the covering portion **22** and the covering portion **24**. The organic layer **160** is formed so as to be extended from the display region **110**A to a portion of the peripheral region **110**B, on the organic insulating layer **152** and the conductive layer **161**B. Specifically, the organic layer **160** is formed from the display region **110**A to a taper region A**1** shown in FIG. **1**, and the covering portion **22** which covers the end face of the organic insulating layer **152**, is formed within the taper region A**1**. Here, the taper region A**1** is a wraparound region of a film at the time of forming the organic layer **160**, and is a region which is formed at the outer edge (outer periphery) the display region **110**A. The organic EL display device **1** has a stacked structure by stacking a wiring layer which is made up of a pixel drive circuit **12**A (corresponding to the pixel drive circuit **140**), the peripheral circuit **12**B, and a metal layer **13**A on the substrate **11**, an inorganic insulating layer **14**, the organic insulating layer **151**, a lower electrode **161**A (and the conductive layer **161**B), the organic insulating layer **152** (second insulating layer), the organic layer **160**, the upper electrode **162**, a protective layer **17**, a filler layer (adhesive layer) **18**A, a seal material **18**B, a color filter **19**A, a BM (black matrix) layer **19**B in the order thereof. Additionally, a substrate for sealing **19** is bonded onto the stacked structure, and the stacked structure is sealed.

The separation groove **21** is arranged in the organic insulating layer **151** between the display region **110**A and the peripheral region **110**B, specifically, in the organic insulating layer **151** of a position corresponding to the metal layer **13**A. The separation groove **21** is a groove for separating the organic insulating layer **151** from the display region **110**A side and the peripheral region **110**B side. In the separation groove **21**, a side wall and a bottom face thereof are covered by the lower electrode **161**A and the conductive layer **161**B. The lower electrode **161**A and the conductive layer **161**B are conductive layers which are formed by the same process and the same material. For example, the lower electrode **161**A and the conductive layer **161**B are separated from each other by an opening P**1** which is arranged in the side wall of the display region **110**A side of the separation groove **21**, and an electrically non-conductive state is formed between both regions. Furthermore, in the embodiment, the separation groove **21** passes through the inorganic insulating layer **14**, and forms a connection portion (cathode contact **21**A described later) where the conductive layer **161**B covering a bottom portion of the separation groove **21** is stacked directly to the metal layer **13**A. An inner diameter of the separation groove **21** is, for example, approximately 10 μm to 100 μm. A depth of the separation groove **21** is obtained by combining a thickness of the organic insulating layer **151** and the thickness of the inorganic insulating layer **14**, and is for example, approximately 500 nm to 5000 nm. When the cathode contact is formed at a spot which is different from the metal layer **13**A, the metal layer **13**A may be not arranged. In this case, for example, the metal layer **13**A in FIG. **1** is removed, and the conductive layer **161**B may be formed so as to come into contact directly with the substrate **11**. Alternatively, the conductive layer **161**B may come into contact with the substrate **11**, through the inorganic insulating layer **14**.

The covering portion **22** and the covering portion **24** have the configurations as described above. That is, the covering portion **22** has the structure of stacking the conductive layer **161**B which is separated from the lower electrode **161**A by the opening P**1**, and the organic layer **160** which is arranged on the organic insulating layer **152**, in the end face of the organic insulating layer **152** which is arranged continually from the display region **110**A to bury the separation groove

21. Furthermore, the end face of the organic layer **160** is sealed (sealing portion **23**) by stacking the conductive layer **161**B and the upper electrode **162**. Hereby, infiltration of moisture that is included in the organic insulating layer **151** which is separated from the peripheral region **110**B side by the separation groove **21** to the organic insulating layer **152** and the organic layer **160**, is prevented. Here, the end face of the organic insulating layer **152** is covered by the organic layer **160**, but may be covered directly by the upper electrode **162**. The covering portion **24** has the structure of stacking the inorganic insulating layer **14** which is arranged in the lower layer of the organic insulating layer **151**, and the conductive layer **161**B on the organic insulating layer **151**. Hereby, the infiltration of the moisture to the organic insulating layer **151** of the peripheral regions **110**B side from the outside, is prevented, and the infiltration of the moisture to the organic layer **160**, the organic insulating layer **152**, and the organic insulating layer **151** of the display region **110**A side, can be further prevented.

The substrate **11** is a support where the white organic EL devices **10**W are configured to form an array on one main face side thereof. For example, as a substrate **11**, quartz, glass, metal foil, a film made of resin, or a sheet made of resin may be used.

The pixel drive circuit **12**A and the peripheral circuit **12**B are drive circuits (drivers for the video display) which are made up of the signal line drive circuit **120**, the scan line drive circuit **130**, and the like. The pixel drive circuit **12**A and the peripheral circuit **12**B are formed on the lower layer side (specifically, between the substrate **11** and the inorganic insulating layer **14**) of the organic insulating layer **151**, on the substrate **11**.

The metal layer **13**A is a portion (cathode contact **21**A) functioning as a wiring layer with respect to the pixel drive circuit **12**A (**140**) and the peripheral circuit **12**B, and functioning as a wiring layer (electrode) for making a contact of the upper electrode **162** described later. For example, the metal layer **13**A is made up of a simple substance or an alloy of metallic elements such as aluminum (Al), copper (Cu) and titanium (Ti).

The inorganic insulating layer **14** is formed almost equally on the pixel drive circuit **12**A, the peripheral circuit **12**B, the metal layer **13**A, a metal layer **13**B, and the substrate **11**. For example, the inorganic insulating layer **14** is made up of an inorganic material such as silicon oxide (SiO_x), silicon nitride (SiN_x), silicon nitrided oxide (SiN_xO_y), titanium oxide (TiO_x) or aluminum oxide (Al_xO_y).

The organic insulating layers **151** and **152** function as an interpixel insulating layer, respectively, and the organic insulating layer **151** is formed on the lower layer side, and the organic insulating layer **152** is formed on the upper layer side. The organic insulating layer **151** of the lower layer side is formed so as to be extended from the display region **110**A to an outer region thereof (for example, an end portion of the substrate **10** through the peripheral region **110**B), on the substrate **11**. The organic insulating layer **152** of the upper layer side is formed so as to be extended from the display region **110**A to the portion (for example, the peripheral region **110**B (within the taper region **A1**) which is close to the display region **110**A) of the peripheral region **110**B, and the end face thereof is covered by the organic layer **160**. For example, the organic insulating layers **151** and **152** are respectively made up of an organic material such as polyimide, acryl, novolac resin or siloxane.

The lower electrode **161**A, the organic layer **160**, and the upper electrode **162** form the stacked structure configuring the white organic EL device **10**W described above.

The lower electrode **161**A functions as a positive pole (anode electrode), and is arranged per the pixel **2** (**2**R, **2**G, and **2**B) of each color within the display region **110**A. Moreover, in the outer region (mainly the peripheral region **110**B) of the display region **110**A, the lower electrode **161** is formed to be extended, and the conductive layer **161**B which is blocked by the opening P**1**, is almost equally formed. That is, the lower electrode **161**A and the conductive layer **161**B are formed by the same process and the same material, and for example, are configured by a metal material (for example, aluminum (Al) or a stack of indium tin oxide (ITO) and silver (Ag)) of which light reflectivity is approximately 70% or more.

The organic layer **160** is formed so as to be extended from the display region **110**A to the portion of the peripheral region **110**B, on the organic insulating layer **152** and the conductive layer **161**B. Specifically, the organic layer **160** is formed from the display region **110**A to the taper region **A1** shown in FIG. **1**, and the covering portion **22** which covers the end face of the organic insulating layer **152**, is formed within the taper region **A1**.

As shown in FIG. **5**, the organic layer **160** has the stacked structure of stacking a positive hole injection layer **160**A, a positive hole transport layer **160**B, a light-emitting layer **160**C, an electron transport layer **160**D, and an electron injection layer **160**E in order from the lower electrode **161** side. Among the layers, the layer other than the light-emitting layer **160**C, may be arranged as necessary. The positive hole injection layer **160**A is arranged in order to enhance positive hole injection efficiency, and to prevent a leakage. The positive hole transport layer **160**B is arranged in order to enhance positive hole transport efficiency to the light-emitting layer **160**C. The light-emitting layer **160**C causes recombination of the electron and the positive hole by spreading an electric field, and generates light. The electron transport layer **160**D is arranged in order to enhance electron transport efficiency to the light-emitting layer **160**C, and the electron injection layer **160**E is arranged in order to enhance electron injection efficiency. Furthermore, a configuration material of the organic layer **160** may be a general low molecular organic material or a general high molecular organic material, and is not limited in particular.

The upper electrode **162** functions as a negative pole (cathode electrode), and is arranged as a common electrode to each pixel **2** within the display region **110**A. The upper electrode **162** is made up of a transparent electrode, and for example, it is preferable that the upper electrode **162** is made up of the material such as indium zinc oxide (IZO) or zinc oxide (ZnO). On the substrate **11**, the upper electrode **162** is formed so as to be extended from the display region **110**A to the outer region thereof (for example, the end portion of the peripheral circuit **12**B). Specifically, the upper electrode **162** is formed to be extended from the organic layer **160** which is arranged on the conductive layer **161**B through the covering portion **22** covering the end face of the organic insulating layer **152**, and the conductive layer **161**B and the upper electrode **162** are directly stacked in the extended region, and the sealing portion **23** blocking the organic layer **160** (and the organic insulating layer **152**) from the outside air is arranged. Hereby, the infiltration of the moisture to the organic insulating layer **152** and the organic layer **160**, is prevented. Furthermore, the organic layer **160** does not necessarily cover the end face of the organic insulating layer **152**, and the upper electrode **162** may be configured to directly cover the end face of the organic insulating layer **152**.

Moreover, the upper electrode **162** and the conductive layer **161**B are directly stacked in the peripheral region **110**B, and thereby, the upper electrode **162** and the metal layer **13**A are electrically connected through the conductive layer **161**B. That is, between the display region **110**A and the peripheral region **110**B, the separation groove **21** separating the organic insulating layer **151** is formed, and the upper electrode **162** and the metal layer **13**A are electrically connected, and the so-called cathode contact **21**A is formed. As shown in FIG. **2**, the cathode contact **21**A is continually arranged so as to surround the separation groove **21** and the display region **110**A. In this manner, the cathode contact **21**A is arranged so as to surround a display panel (display region **110**A), and thereby, it is possible to prevent a concern of lowering luminance at a center portion of the panel at the time of enlargement. Furthermore, the cathode contact **21**A is not necessarily arranged continually in the vicinity of the display region **110**A, and may be cut in the portion thereof or at a plurality of spots.

The protective layer **17** is formed on the upper electrode **162**, and is formed continually to the substrate **11**, for example, so as to cover the peripheral circuit **12**B, the inorganic insulating layer **14**, the organic insulating layer **151**, the conductive layer **161**B, and the end face of the upper electrode **162**. For example, the protective layer **17** is made up of the inorganic material such as silicon oxide (SiO_x), silicon nitride (SiN_x), silicon nitride oxide (SiN_xO_y), titanium oxide (TiO_x) or aluminum oxide (Al_xO_y).

The filler layer **18**A is formed on the protective layer **17**, and functions as an adhesive layer. For example, the filler layer **18**A is made up of epoxy resin, acryl resin or the like. Moreover, the filler layer **18**A may be formed using a sheet shaped resin film. Furthermore, the filler layer **18**A is not necessarily arranged, and a portion of the filler layer **18**A may be hollow.

The seal material **18**B is arranged in the end portion (peripheral portion) of the substrate **11**, and is a member for sealing the respective layers between the substrate **11** and the substrate for sealing **19**, from the outside. Additionally, for example, the seal material **18**B is made up of epoxy resin, acryl resin or the like. For example, a getter agent adsorbing the moisture, carbon dioxide (CO_2) or the like, may be added to the seal material **18**B.

The substrate for sealing **19** along with the filler layer **18**A and the seal material **18**B, seal the white organic EL device **10**W. The substrate for sealing **19** is configured of the material such as transparent glass with respect to each color light which exits from the red pixel **2**R, the green pixel **2**G, and the blue pixel **2**B. On the face of the substrate **11** side in the substrate for sealing **19**, for example, the color filter **19**A which is made up of a red filter, a green filter, and a blue filter, is arranged respectively in the position corresponding to each pixel **2**, and the BM layer **19**B (light-shielding film) is arranged between the respective pixels **2**. Hereby, white light which is emitted from each white organic EL device **10**W within the red pixel **2**R, the green pixel **2**G, and the blue pixel **2**B, transmits the color filter of each color, and thereby, red light, green light, and blue light respectively exit. Moreover, the substrate for sealing **19** absorbs the light which is reflected in the red pixel **2**R, the green pixel **2**G, the blue pixel **2**B, and the wiring therebetween, and improves a contrast.

Method for Manufacturing Organic EL Display Device **1**

For example, the organic EL display device **1** may be manufactured as follows.

First, on the substrate **11** which is made up of the material described above, the pixel drive circuit **12**A (**140**) and the peripheral circuit **12**B are formed. Along therewith, after forming the film by a sputter method, the metal layer **13**A which is made up of the material described above, is formed by patterning the metal layer **13**A into a desired shape, for example, by a photolithography method and etching. Thereafter, the inorganic insulating layer **14** which is made up of the material described above, is formed, for example, using a plasma chemical vapor deposition (CVD) method, on the pixel drive circuit **12**A, the peripheral circuit **12**B, and the metal layer **13**A. However, at this time, the film formation method is not limited to the CVD method, and for example, a physical vapor deposition (PVD) method, an atomic layer deposition (ALD) method, a (vacuum) evaporation method or the like may be used. Next, the metal layer **13**A is patterned so as to be exposed at the same time as the patterning by the photolithography method within the display region **110**A, and the inorganic insulating layer **14** on the metal layer **13**A is removed by the etching.

Subsequently, on the inorganic insulating layer **14**, for example, the organic insulating layer **151** which is made up of the material described above, is formed by a coating method (wet method) such as a spin coat method or a droplet ejection method. Thereafter, the separation groove **21** is formed between the display region **110**A and the peripheral region **110**B, for example, by the photolithography method, and separates the organic insulating layer **151** from the display region **110**A side and the peripheral region **110**B side. Next, on the organic insulating layer **151**, after forming the film by the sputter method, the lower electrode **161**A which is made up of the material described above, and the metal film forming the conductive layer **161**B, are formed by patterning the lower electrode **161**A and the metal film into the desired shape, for example, by the photolithography method. Specifically, as shown in FIG. **1**, the lower electrode **161** is cut in the vicinity of a boundary between the display region **110**A and the peripheral region **110**B, and the electrically non-conductive state is formed between both regions. Hereby, a side face and a bottom portion of the separation groove **21**, and the end face of the organic insulating layer **151** of the peripheral region **110**B side, are covered respectively by the lower electrode **161**A and the conductive layer **161**B corresponding thereto. Moreover, the end face of the outer edge side the organic insulating layer **151** of the peripheral region **110**B side which is separated by the separation groove **21**, is covered by the conductive layer **161**B.

Next, on the lower electrode **161**A, the conductive layer **161**B, and the organic insulating layer **151**, for example, the organic insulating layer **152** which is made up of the material described above, is formed by the coating method (wet method) such as the spin coat method or the droplet ejection method. Thereafter, the organic insulating layer **152** of the partial region of the peripheral region **110**B, is removed for example, by the photolithography method. Subsequently, on the organic insulating layer **152**, each layer of the organic layer **160** which is made up of the material described above, is formed for example, by the evaporation method, using an area mask covering the display region **110**A. At this time, actually, from the display region **110**A to the taper region **A1** shown in FIG. **1**, the organic layer **160** is formed to wrap around.

Next, the upper electrode **162** which is made up of the material described above, is formed on the organic layer **160** and the conductive layer **161**B, for example, using the sputter method. Subsequently, on the upper electrode **162**, the protective layer **17** which is made up the material described above is formed, for example, using the plasma CVD method, the PVD method, the ALD method, the evaporation method or the like.

Next, on the substrate for sealing **19** which is made up of the material described above, for example, after the coating by the sputter method, the color filter **19**A and the BM layer

19B are respectively formed by taper turning using the photolithography method. Subsequently, on the substrate for sealing **19**, the filler layer **18**A and the seal material **18**B which are made up of the materials described above, are respectively formed. Finally, the filler layer **18**A and the seal material **18**B are put therebetween, and the substrate for sealing **19** is bonded. As described above, the organic EL display device **1** shown in FIG. **1**, is completed.

Operations and Effects of Organic EL Display Device **1**

In the organic EL display device **1**, the scan signal is supplied from the scan line drive circuit **130** to each pixel **2**, through the gate electrode of the write-in transistor Tr**2**, and the image signal is stored in the storage capacitor Cs, through the write-in transistor Tr**2** from the signal line drive circuit **120**. That is, ON and OFF of the drive transistor Tr**1** is controlled depending on the signal which is stored in the storage capacitor Cs. Hereby, a drive current Id is injected into the white organic EL device **10**W, and the emitting of the light occurs by recombining the positive hole and the electron. Here, since the organic EL display device **1** is the upper face light-emitting type (top emission type), the light is taken out by transmitting the upper electrode **162**, the protective layer **17**, the filler layer **18**A, the color filter (not shown) of each color, and the substrate for sealing **19**. In this manner, the video display (color video display) is made in the organic EL display device **1**.

Incidentally, the organic EL display device generally has problems that time-dependent stability is low and a lifespan is short, such that deterioration of the organic layer due to moisture absorption is generated in the organic EL device, the light-emitting luminance is lowered, or the emitting of the light is unstable in the organic EL device.

COMPARATIVE EXAMPLE

In an organic EL display device (organic EL display device **100**) according to Comparative Example shown in FIG. **6**, by arranging a structure of preventing the infiltration of the moisture to the organic layer **160** as follows, the above problems (deterioration of the organic layer in the organic EL device which is caused by the moisture) are solved. FIG. **6** is a diagram illustrating a cross-sectional configuration of the organic EL display device **100** according to Comparative Example. In the organic EL display device **100**, as a structure of preventing the infiltration of the moisture to the organic layer **160**, two (two types) separation grooves **101** and **102** are formed in the position (outer edge side and outer periphery side of the display region **110**A) surrounding the display region **110**A.

Specifically, first, in the region (vicinity of the end portion of the substrate **11**) corresponding to the seal material **18**B, the separation groove **101** which separates the organic insulating layers **151** and **152** respectively from the inner region thereof and the outer region thereof, is formed. Moreover, a separation groove **102** is formed in the region between the display region **110**A and the peripheral region **110**B, specifically, in the region between the outer peripheral side (outer edge side) of the taper region A**1** described before and a mask shift region A**2**, and the peripheral region **110**B. The separation groove **102** is different from the separation groove **21** in the organic EL display device **1** according to the embodiment, and separates both of the organic insulating layers **151** and **152** from the display region **110**A side and the peripheral region **110**B side.

In the organic EL display device **100** according to Comparative Example, by arranging the separation groove **102**, the moisture which is present in the organic insulating layers **151** and **152** of the peripheral region **110**B side, is avoided from infiltrating the display region **110**A side by passing through the organic insulating layers **151** and **152**. Consequently, it is possible to prevent the infiltration of the moisture to the organic layer **160** from the outside by the separation groove **102**, and in addition thereto, it is possible to suppress the deterioration of the organic layer **160** which is caused by the moisture left behind within the organic EL display device **100** passing through the organic insulating layers **151** and **152**.

However, as described before, when the area mask is used at the time of forming the organic layer **160** configuring the white organic EL device **10**W, the following problems are generated in the organic EL display device **100** of Comparative Example. That is, in this case, in consideration of an alignment shift (mask shift region A**2** of the drawing) of the area mask and wraparound (taper region A**1** of the drawing) of the film, the separation groove **102** is necessary to be formed in the position which is sufficiently distant from the display region **110**A. Specifically, as described above, the separation groove **102** is formed in the region between the outer periphery side (outer edge side) of the taper region A**1** and the mask shift region A**2**, and the peripheral region **110**B. The reason is as follows. Since the separation groove **102** is a groove for separating both of the organic insulating layers **151** and **152**, it is not possible to form the separation groove **102** in the taper region A**1** where the organic layer **160** is formed (may be formed), and the mask shift region A**2**.

From this, in the organic EL display device **100** of Comparative Example, a necessity to widen a frame is generated as shown in FIG. **6**, and it is difficult to achieve frame narrowing. In addition, since the necessity to widen the distance between the display region **110**A and the peripheral region **110**B is generated, the moisture which is included within the organic insulating layers **151** and **152** infiltrates the organic layer **160** in the region (inner region of the separation groove **102**), and thereby, the organic layer **160** deteriorates.

Embodiment

In contrast thereto, in the organic EL display device **1** of the embodiment, differently from Comparative Example, the separation groove **21** which separates the organic insulating layer **151** from the display region **110**A side and the peripheral region **110**B side, is arranged between the display region **110**A and the peripheral region **110**B. Moreover, the outer periphery (outer edge) of the organic insulating layer **152** is removed than the assumed taper region A**1**, and the end face of the organic insulating layer **152** is covered (covering portion **22**) by the organic layer **160** or the upper electrode **162**. Furthermore, the organic layer **160** (and the organic insulating layer **152**) is sealed (sealing portion **23**) by the conductive layer **161**A, and the upper electrode **162** which is formed in the upper layer than the organic layer **160**. That is, in the organic EL display device **1**, differently from Comparative Example, the organic insulating layer **151** of the lower layer side is selectively separated on an inner periphery side than the taper region A**1** and the mask shift region A**2**. Moreover, the organic insulating layer **152** which is arranged in the peripheral region **110**B, is removed from the display region **110**A more than a formation region of the organic layer **160**, and the organic layer **160** along with the organic insulating layer **152** are sealed by the conductive layer **161**B and the upper electrode **162**. Furthermore, the end face of the outer edge side of the organic insulating layer **151** which is separated from the peripheral region **110**B side by the separation groove **21**, is covered (covering portion **24**) by the conductive layer **161**B.

Hereby, in the embodiment, differently from Comparative Example in which the separation groove **102** is formed, the infiltration of the moisture that is included within the organic insulating layer **151** which is formed in the peripheral region **110**B to the organic layer **160**, is avoided. Additionally, an amount of the moisture which has the concern of infiltrating the organic layer **160** from the organic insulating layer **152**, is reduced. Still more, the infiltration of the moisture to the organic insulating layer **151** of the peripheral region **110**B side from the outside, or the infiltration of gas which has the concern of deteriorating the organic layer **160**, is prevented, and the infiltration of the moisture to the organic layer **160**, the organic insulating layer **152** or the organic insulating layer **151** of the display region **110**A side, is further reduced.

Moreover, since the structure (separation groove **21**) of preventing the infiltration of the moisture to the organic layer **160**, can be formed between the display region **110**A and the peripheral region **110**B (inner region of the taper region A**1** and the mask shift region A**2** in Comparative Example), it is possible to form the peripheral circuit **12**B (peripheral region **110**B) on the display region **110**A side, in comparison with Comparative Example. That is, it is possible to narrow (shorten the distance between the display region **110**A and the peripheral region **110**B) the frame in comparison with Comparative Example, and the frame narrowing (size reduction of the display device, and cost reduction) is realized.

Additionally, in the separation groove **21** according to the embodiment, by stacking the conductive layer **161**B where the upper electrode **162** is stacked, and the metal layer **13**A, the upper electrode **162** and the metal layer **13**A are electrically connected. That is, between the display region **110**A and the peripheral region **110**B, since the cathode contact **21**A is arranged so as to continually surround the display region **110**A, it is possible to reduce luminance unevenness within the display panel.

In the embodiment described above, between the display region **110**A and the peripheral region **110**B, the separation groove **21** which separates the organic insulating layer **151** from the display region **110**A side and the peripheral region **110**B side, is formed. Moreover, since the covering portion **22** where the end face of the organic insulating layer **152** is covered by the organic layer **160** or the upper electrode **162**, and the sealing portion **23** where the organic layer **160** is sealed by the conductive layer **161**B and the upper electrode **162**, are arranged, it is possible to avoid the infiltration of the moisture to the organic layer **160**. Still more, since the covering portion **24** where the end face of the outer edge side of the organic insulating layer **151** which is separated from the peripheral region **110**B side by the separation groove **21** is covered by the conductive layer **161**B, is arranged, the infiltration of the moisture to the organic insulating layer **151** of the peripheral region **110**B side from the outside, or the infiltration of the gas which has the concern of deteriorating the organic layer **160**, can prevented. Accordingly, it is possible to improve reliability by suppressing the deterioration of the organic EL device **10**, and it is possible to shorten the distance between the display region **110**A and the peripheral region **110**B, and it is possible to achieve the frame narrowing.

2. MODIFICATION EXAMPLE

Subsequently, Modification Examples (Modification Examples 1 to 3) of the embodiment will be described. Furthermore, the same reference signs are attached to the same components in the embodiment, and the description will be appropriately omitted.

MODIFICATION EXAMPLE 1

FIG. **7** is a diagram illustrating a cross-sectional configuration of an organic EL display device (organic EL display device **1**A) according to Modification Example 1 of the embodiment. In the organic EL display device **1**A, a point that the metal layer **13**B is arranged on the outside of the peripheral circuit **12**B, and the conductive layer **161**B and the upper electrode **162** are electrically connected in the metal layer **13**B, is different from the embodiment. FIG. **8** is a diagram illustrating a planar configuration of the organic EL display device **1**A shown in FIG. **7**, and FIG. **7** is a cross-sectional view of the organic EL display device **1**A along a VII-VII line shown in FIG. **8**.

The same effects as the embodiment, can be obtained in the organic EL display device **1**A having such the configuration. Moreover, the metal layer **13**B is arranged on the outside of the peripheral circuit **12**B, and thereby, it is possible to lower the resistance more than the cathode contact of only the conductive layer **161**B and the metal layer **13**A, and it is possible to further reduce the luminance unevenness of the display panel. The stacked structure of the upper electrode **162** through the metal layer **13**B and the conductive layer **161**B, may be arranged continually in the vicinity of the display region **110**A as the cathode contact **21**A shown in FIG. **2**, or for example, as shown in FIG. **8**, may be arranged respectively at four corners of the peripheral region **110**B, in a state of being separated.

Modification Example 2

FIG. **9** and FIG. **10** are diagrams illustrating cross-sectional configurations of organic EL display devices (organic EL display devices **1**B and **1**C) according to Modification Example 2. In the organic EL display devices **1**B and **1**C, the point that one (organic EL display device **1**B) separation groove is formed, or a plurality (organic EL display device **1**C) of separation grooves (separation grooves **25** (**25**A and **25**B)) are formed in the organic insulating layer **151** of the outside more than the separation groove **21**, is different from the embodiment. Additionally, FIG. **11** and FIG. **12** are diagrams in a case of combining Modification Example 2 and Modification Example 1, that is, diagrams illustrating the cross-sectional configuration of the organic EL display device where the metal layer **13**B is arranged on the outside of the peripheral circuit **12**B, and the conductive layer **161**B and the upper electrode **162** are electrically connected in the metal layer **13**B, and one (organic EL display device **1**D) separation groove is formed or the plurality (organic EL display device **1**E) of separation grooves **25** (**25**A and **25**B) are formed in the organic insulating layer **151** between the separation groove **21**, and an electrical connection portion C of the metal layer **13**B and the upper electrode **162**. In Modification Example 2, an example of arranging the separation groove which separates the organic insulating layer **151**, by one (separation groove **25**) or two (separation grooves **25**A and **25**B) is shown, but is not limited thereto, and may be formed by three of more.

The same effects as the embodiment can be obtained in the organic EL display devices **1**B to **1**E having such the configurations. Moreover, by arranging the separation groove **25** of one or the separation grooves **25** (**25**A and **25**B) of two or more, in the organic insulating layer **151** of the outside more than the separation groove **21**, the effect of further reducing the moisture which is included within the organic insulating layer **151**, and the infiltration of the moisture from the outside in the case of the organic insulating layer **151** as an infiltration path, is obtained.

Modification Example 3

FIG. **13** is a diagram illustrating a cross-sectional configuration of an organic EL display (organic EL display device **1**F) according to Modification Example 3. FIG. **14** is a diagram of an organic EL display device (organic EL display device **1**G) in the case of combining Modification Example 3 and Modification Example 1. In the organic EL display device **1**F and the organic EL display device **1**G, the point that a high resistance layer **163** is arranged between the organic layer **160** and the upper electrode **162**, is different from the embodiment and Modification Example 1.

As shown in FIG. **13** and FIG. **14**, for example, the high resistance layer **163** is arranged by being extended from the formation region the organic layer **160** so as to cover the upper face and the side face (end face) of the organic layer **160**, and the end face thereof is sealed by the conductive layer **161**B and the upper electrode **162**, in the same manner as the organic layer **160** in the embodiment. As a material of the high resistance layer **163**, for example, the material of which resistivity is 1 Ωcm to 10^7 Ωcm, specifically, niobium oxide (NbO_x), titanium oxide (TiO_x), molybdenum oxide (MoO_x), tantalum oxide (TaO_x), a mixture of niobium oxide (NbO_x) and titanium oxide (TiO_x), a mixture of titanium oxide (TiO_x) and zinc oxide (ZnO_x), or a mixture of silicon oxide (SiO_x) and tin oxide (SnO_x) may be used.

In this manner, by arranging the high resistance layer **163** between the organic layer **160** and the upper electrode **162**, the effect of suppressing a blinking point is achieved in the organic EL display devices **1**F and **1**G, in addition to the effects of the embodiment.

3. APPLICATION EXAMPLE

Hereinafter, Application Examples of the organic EL display devices (organic EL display devices **1**, and **1**A to **1**G) which are described in the embodiment and Modification Examples 1 to 3, will be described. The organic EL display device of the embodiment, can be applied to a display device of electronic apparatuses of all fields that displays a video signal which is input from the outside, or the video signal which is internally generated, as an image or video, such as a television device, a digital camera, a notebook type personal computers, a portable terminal device such as a cellular phone, or a video camera. In particular, the organic EL display device of the embodiment is suitable for a small and medium sized display for mobile. Hereinafter, an example thereof is shown.

APPLICATION EXAMPLE 1

FIG. **15**A and FIG. **15**B are diagrams illustrating an appearance of a smart phone **220** according to Application Example 1. For example, the smart phone **220** has a display portion **221**, and an operation portion **222** on a front side thereof, and has a camera **223** on a rear side thereof. The organic EL display device of the embodiment or the like, is mounted on the display portion **221**.

APPLICATION EXAMPLE 2

FIG. **16** is a diagram illustrating an appearance of a television device according to Application Example 2. For example, the television device has a video display screen portion **300** including a front panel **310** and a filter glass **320**. The video display screen portion **300** corresponds to the organic EL display device of the embodiment or the like.

APPLICATION EXAMPLE 3

FIG. **17**A and FIG. **17**B are diagrams illustrating an appearance of a tablet personal computer **440** according to Application Example 3. For example, the tablet personal computer **440** has a case **420** in which a touch panel portion **410** and an operation portion **430** are placed. The organic EL display device of the embodiment or the like, is mounted on the touch panel portion **410**.

OTHER MODIFICATION EXAMPLES

As described above, the present disclosure is described using the embodiment, Modification Examples 1 to 3, and Application Examples, but the present disclosure is not limited to the embodiment or the like, and can be variously modified.

For example, the material, the thickness, the film formation method and the film formation condition of each layer which is described in the embodiment or the like, are not limited, and other materials and other thickness may be used, or other film formation methods and other film formation conditions may be used. Specifically, for example, in the embodiment or the like, the case that "the first insulating layer and the second insulating layer" are respectively the organic insulating layers (organic insulating layers **151** and **152**), is described in the present disclosure, but in some cases, the insulating layer may be configured of other materials, other than the organic material.

Moreover, in the embodiment or the like, the case that the organic EL display device is the upper face light-emitting type (top emission type), is described, but it is not limited thereto, and for example, may be configured to be a lower face light-emitting type (bottom emission type). In the case of the lower face light-emitting type organic EL display device, for example, the lower electrode **161** is formed using any one of ITO, IZO and ZnO, and the upper electrode **162** is formed using Al, MgAg, or the stacked structure of ITO, Ag and ITO, and a stacked order of the organic layer **160** is formed reversely to the embodiment. In this case, the color filter **19**A is arranged between the layer where TFT (Tr**1**) is formed, and the organic insulating layer **151**. In the organic EL display device of a combustible light-emitting type, the light from the light-emitting layer within the organic layer **160**, is taken out to the outside by transmitting the lower electrode and the substrate **11**. Moreover, in the organic EL display device, a so-called microcavity (microresonator) structure may be arranged. For example, the microresonator structure is a structure that the plurality of layers having a predetermined refractive index difference are stacked between a pair of reflective films, and optical confinement is performed by repeatedly reflecting the incident light between the pair of reflective films.

Furthermore, in the embodiment or the like, the configuration of the organic EL device is described using a specific example, but all layers is not necessarily included, and other layers may be included. For example, in the embodiment or the like, the configuration of the organic layer **160** of the organic EL device (white organic EL device **10**W), is the stacked structure of stacking the positive hole injection layer **160**A, the positive hole transport layer **160**B, the light-emitting layer **160**C, the electron transport layer **160**D, and the electron injection layer **160**E in order from the lower electrode **161** side, but is not limited thereto. For example, a so-called stack structure, specifically, may be a configuration of forming a charge generation layer on the stacked structure, and stacking a positive hole injection layer **160**A', a positive hole transport layer **160**B', a light-emitting layer **160**C', an electron transport layer **160**D', and an electron injection layer **160**E' on the charge generation layer. Moreover, the charge generation layer is put therebetween, and the respective layers (for example, the position hole injection layers **160**A and **160**A') may be formed by the same materials to each other, or may be formed using different materials. It is preferable that the material which is suitable for the respective light-emitting layers **160**C and **160**C' is used. Still more, the respective light-emitting layers **160**C and **160**C' are not necessarily the simple substances, and the light-emitting layer which emits the light of the different color may be stacked into two or more layers. Specifically, for example, when the white organic EL device **10**W is used as an organic EL device in the same manner as the embodiment, a blue light-emitting layer may be formed as a light-emitting layer **160**C, and a yellow light-emitting layer may be formed as a light-emitting layer **160**C'. Alternatively, the white EL device **10**W may be used by stacking a blue light-emitting layer as a light-emitting layer **160**C, a red light-emitting layer as a light-emitting layer **160**C', and two layers of green light-emitting layers.

Furthermore, among the organic insulating layer **151** that is separated by the separation groove **21**, there is no problem that the organic insulating layer **151** which is arranged on the peripheral region **110**B side is removed.

Additionally, in the embodiment or the like, an active matrix type display device is described, but the present disclosure can be applied to a passive matrix type display device. Moreover, the configuration of the pixel drive circuit for an active matrix drive, is not limited to the description in the embodiment, and a capacitor device or a transistor may be added as necessary. In this case, depending on alteration of the pixel drive circuit, in addition to the signal line drive circuit **120** and the scan line drive circuit **130**, a necessary drive circuit may be added.

Moreover, in the embodiment or the like, three types of the red pixel **2**R, the green pixel **2**G, and the blue pixel **2**B are exemplified as a color pixel, but are not limited thereto, and for example, the color pixel such as a white pixel **2**W or a yellow pixel **2**Y, may be combined. The effects described herein are simply exemplified, and are limited thereto. Still more, other effects may be obtained.

Furthermore, the present disclosure may be configured as follows.

(1) An organic EL display device including a display region where a plurality of pixels having a light-emitting device which is stacked respectively in order of an organic layer including a first electrode and a light-emitting layer, and a second electrode from a substrate side, are arranged, a peripheral region that is arranged on an outer edge side of the display region, and has a peripheral circuit, a first insulating layer of a lower layer side and a second insulating layer of an upper layer side that are arranged so as to be extended to the peripheral region from the display region, a first separation groove that is arranged in the first insulating layer between the display region and the peripheral region, a first conductive layer that is arranged on the first insulating layer of the peripheral region, through a bottom portion from a side face of the first separation groove, a first covering portion where at least an end face of the second insulating layer is covered by the organic layer or the second electrode, a sealing portion that is arranged on an outer edge side of the first covering portion, and is configured by stacking the first conductive layer and the second electrode, and a second covering portion where an end face of an outer edge side of the first insulating layer which is separated from the peripheral region side by the first separation groove, is covered by the first conductive layer.

(2) The organic EL display device according to the above (1), in which a second conductive layer and a third insulating layer are arranged between the substrate and the first insulating layer in order thereof from the substrate side, the first separation groove separates the first insulating layer and the third insulating layer, and a connection portion where the first conductive layer and the second conductive layer are stacked in the bottom portion of the first separation groove, is formed.

(3) The organic EL display device according to the above (2), in which the second electrode and the second conductive layer are electrically connected through the first conductive layer.

(4) The organic EL display device according to any one of the above (1) to (3), in which the first electrode and the first conductive layer are formed by the same process.

(5) The organic EL display device according to any one of the above (1) to (4), further including a second separation groove that is arranged in the peripheral region, and separates the first insulating layer from an inner region side and an outer region side.

(6) The organic EL display device according to any one of the above (3) to (5), in which a wall face and a bottom face of the second separation groove are covered by the first conductive layer, and the second separation groove is embedded by the second electrode.

(7) The organic EL display device according to any one of the above (1) to (6), further including a high resistance layer that is arranged between the organic layer and the second electrode.

(8) The organic EL display device according to any one of the above (1) to (7), in which the first insulating layer and the second insulating layer are organic insulating layers, and the third insulating layer is an inorganic insulating layer.

(9) The organic EL display device according to any one of the above (1) to (8), in which a seal material is arranged in an end portion of the substrate.

(10) The organic EL display device according to any one of the above (2) to (9), in which the peripheral circuit is formed on a lower layer side of the third insulating layer on the substrate.

(11) The organic EL display device according to any one of the above (1) to (10), in which the light-emitting device is arranged on the substrate in order of a positive hole injection layer, a positive hole transport layer, the light-emitting layer, an electron transport layer, and an electron injection layer, from the first electrode side.

(12) The organic EL display device according to any one of the above (1) to (10), in which the light-emitting device is arranged on the substrate in order of a positive hole injection layer, a positive hole transport layer, the light-emitting layer, an electron transport layer, an electron injection layer, a charge generation layer, the positive hole injection layer, the positive hole transport layer, the light-emitting layer, the electron transport layer, and the electron injection layer, from the first electrode side.

(13) The organic EL display device according to any one of the above (1) to (12), in which the plurality of pixels are made up of red pixels, green pixels, and blue pixels, or red pixels, green pixels, blue pixels, and white pixels.

(14) An electronic apparatus including an organic EL display device, in which the organic EL display device includes a display region where a plurality of pixels having a light-

emitting device which is stacked respectively in order of an organic layer including a first electrode and a light-emitting layer, and a second electrode from a substrate side, are arranged, a peripheral region that is arranged on an outer edge side of the display region, and has a peripheral circuit, a first insulating layer of a lower layer side and a second insulating layer of an upper layer side that are arranged so as to be extended to the peripheral region from the display region, a first separation groove that is arranged in the first insulating layer between the display region and the peripheral region, a first conductive layer that is arranged on the first insulating layer of the peripheral region, through a bottom portion from a side face of the first separation groove, a first covering portion where at least an end face of the second insulating layer is covered by the organic layer or the second electrode, a sealing portion that is arranged on an outer edge side of the first covering portion, and is configured by stacking the first conductive layer and the second electrode, and a second covering portion where an end face of an outer edge side of the first insulating layer which is separated from the peripheral region side by the first separation groove, is covered by the first conductive layer.

It should be understood by those skilled in the art that various modifications, combinations, sub-combinations and alterations may occur depending on design requirements and other factors insofar as they are within the scope of the appended claims or the equivalents thereof.

What is claimed is:

1. An organic EL display device comprising:

a display region including a plurality of pixels respectively having a light-emitting device which is stacked respectively in order of an organic layer including a first electrode and a light-emitting layer, and a second electrode from a substrate side;

a peripheral region that is arranged on an outer edge side of the display region, and has a peripheral circuit;

a first insulating layer of a lower layer side and a second insulating layer of an upper layer side that are arranged so as to be extended to the peripheral region from the display region;

a first separation groove that is arranged in the first insulating layer between the display region and the peripheral region;

a first conductive layer that is arranged on the first insulating layer of the peripheral region, through a bottom portion from a side face of the first separation groove;

a first covering portion where at least an end face of the second insulating layer is covered by the organic layer or the second electrode;

a sealing portion that is arranged on an outer edge side of the first covering portion, and is configured by stacking the first conductive layer and the second electrode;

a second covering portion where an end face of an outer edge side of the first insulating layer which is separated from the peripheral region side by the first separation groove, is covered by the first conductive layer;

a second conductive layer that is arranged between the substrate and the first insulating layer;

a third insulating layer that is arranged between the second conductive layer and the first insulating layer, the third insulating layer being separated by the first separation groove with the first insulating layer; and

a connection portion that is arranged in the bottom portion of the first separation groove, the connection portion includes a stack having the first conductive layer and the second conductive layer.

2. The organic EL display device according to claim 1, wherein the second electrode and the second conductive layer are electrically connected through the first conductive layer.

3. The organic EL display device according to claim 1, wherein the first electrode and the first conductive layer are formed by the same process.

4. The organic EL display device according to claim 1, further comprising:

a second separation groove that is arranged in the peripheral region, and separates the first insulating layer from an inner region side and an outer region side.

5. The organic EL display device according to claim 4, wherein a wall face and a bottom face of the second separation groove are covered by the first conductive layer, and the second separation groove is embedded by the second electrode.

6. The organic EL display device according to claim 1, further comprising:

a high resistance layer that is arranged between the organic layer and the second electrode.

7. The organic EL display device according to claim 1, wherein the first insulating layer and the second insulating layer are organic insulating layers, and the third insulating layer is an inorganic insulating layer.

8. The organic EL display device according to claim 1, wherein a seal material is arranged in an end portion of the substrate.

9. The organic EL display device according to claim 1, wherein the peripheral circuit is formed on a lower layer side of the third insulating layer on the substrate.

10. The organic EL display device according to claim 1, wherein the light-emitting device is arranged on the substrate in order of a positive hole injection layer, a positive hole transport layer, the light-emitting layer, an electron transport layer, and an electron injection layer, from the first electrode side.

11. The organic EL display device according to claim 1, wherein the light-emitting device is arranged on the substrate in order of a positive hole injection layer, a positive hole transport layer, the light-emitting layer, an electron transport layer, an electron injection layer, a charge generation layer, the positive hole injection layer, the positive hole transport layer, the light-emitting layer, the electron transport layer, and the electron injection layer, from the first electrode side.

12. The organic EL display device according to claim 1, wherein the plurality of pixels are made up of red pixels, green pixels, and blue pixels, or red pixels, green pixels, blue pixels, and white pixels.

13. An electronic apparatus comprising:

an organic EL display device,

wherein the organic EL display device includes a display region including a plurality of pixels respectively having a light-emitting device which is stacked respectively in order of an organic layer including a first electrode and a light-emitting layer, and a second electrode from a substrate side,

a peripheral region that is arranged on an outer edge side of the display region, and has a peripheral circuit,

a first insulating layer of a lower layer side and a second insulating layer of an upper layer side that are arranged so as to be extended to the peripheral region from the display region,

a first separation groove that is arranged in the first insulating layer between the display region and the peripheral region, a first conductive layer that is arranged on the first insulating layer of the peripheral region, through a bottom portion from a side face of the first separation groove,

a first covering portion where at least an end face of the second insulating layer is covered by the organic layer or the second electrode,

a sealing portion that is arranged on an outer edge side of the first covering portion, and is configured by stacking the first conductive layer and the second electrode,

a second covering portion where an end face of an outer edge side of the first insulating layer which is separated from the peripheral region side by the first separation groove, is covered by the first conductive layer,

a second conductive layer that is arranged between the substrate and the first insulating layer,

a third insulating layer that is arranged between the second conductive layer and the first insulating layer, the third insulating layer being separated by the first separation groove with the first insulating layer, and

a connection portion that is arranged in the bottom portion of the first separation groove, the connection portion includes a stack having the first conductive layer and the second conductive layer.

14. The electronic apparatus according to claim **13**, wherein the second electrode and the second conductive layer are electrically connected through the first conductive layer.

15. The electronic apparatus according to claim **13**, wherein the first electrode and the first conductive layer are formed by the same process.

16. The electronic apparatus according to claim **13**, further comprising:

a second separation groove that is arranged in the peripheral region, and separates the first insulating layer from an inner region side and an outer region side.

17. The electronic apparatus according to claim **16**, wherein a wall face and a bottom face of the second separation groove are covered by the first conductive layer, and the second separation groove is embedded by the second electrode.

18. The electronic apparatus according to claim **13**, further comprising:

a high resistance layer that is arranged between the organic layer and the second electrode.

19. The electronic apparatus according to claim **13**, wherein the first insulating layer and the second insulating layer are organic insulating layers, and the third insulating layer is an inorganic insulating layer.

20. The electronic apparatus according to claim **13**, wherein a seal material is arranged in an end portion of the substrate.

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